Manual for Timber Reconnaissance

U.S. Department of Agriculture

Forest Service

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MANUAL

FOR

Timber Reconnaissance

1914

FOR USE OF FOREST OFFICERS ONLY

District One, Missoula, Mont.

F. A. SILCOX, District Forester

MISSOULIAN JOB ROOMS, MISSOULA, MONTANA.

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INTRODUCTION.

The following instructions give in detail the methods of reconnaissance which have been authorized by the Forester and by the District Office for District 1. They are based on the conduct of intensive projects by standard crews. They should also be applied, however, to extensive projects and to cases where circumstances make it necessary that very small parties or even individuals examine bodies of timber in preparation for a sale. In intensive projects of standard size, deviations from these instructions should be made only with the consent of the District Office.

EXTENSIVE RECONNAISSANCE.

For the intelligent selection of areas which will make attractive logging chances and which later may need to be covered by intensive reconnaissance, and to make possible a fair division of reconnaissance funds between Forests to secure data for use in a rough calculation of the annual growth and also of value for other purposes in the administration of the forest, a systematic cataloging of timber resources is of vital importance Supervisors should, therefore, take advantage of every opportunity to complete extensive reconnaissance over their Forests This work can be done in many cases for each ranger district by the Ranger in charge. but should be directed by some one man on each Forest who is responsible for assembling and checking all the data received.

The data which should be obtained in connection with extensive reconnaissance is as follows:

1. A type map usually on the scale of one mile to the inch, the typing being on a rather broad basis.
2. An age class map similar to the type map.
3. An approximate estimate by species for each watershed.

Considerable variation in methods will be necessary due to differing local conditions In general much cruder and more rapid methods than those described in these instructions will be necessary Under normal conditions one man working alone should cover about a township a week The details of these instructions for intensive reconnaissance will obviously be merely suggestive as to the methods to be used.

INTENSIVE RECONNAISSANCE.

Object and Scope—The object of all intensive reconnaissance is to secure data for (1) timber sales and (2) working plans. While the former object is immediate and the latter may be postponed, the reconnaissance data collected should be sufficiently inclusive so that no subsequent field work is necessary except to secure estimates of logging cost for stumpage appraisals and to determine the exact sale boundaries after applications have been received.

The data required for these two purposes are, first, a map showing topography, culture,, Forest types, age classes and other information; second, estimates by convenient subdivision in such form as to be of use both for sales and for regulating cut; and third, descriptive notes covering the silvicultural conditions and the factors affecting logging.

Selection of Areas to Be Covered—The following principles will govern the order of selection of areas to be covered:

1. Areas for which formal or informal sale applications have been received and where sales are desirable.
2. Areas within which desirable sales can undoubtedly be made in the near future if reconnaissance data are available.
3. Divisions in which there is danger of overcutting either in large or small sales, (a) in excess of the amounts which should be reserved for local needs and in guaranteeing a reasonable operating life for improvements constructed in connection with sales, and (b) in excess of sustained yield.

For the present it will be necessary to limit reconnaissance strictly to areas of the first class.

PRELIMINARY FIELD EXAMINATION.

To insure that a proposed project falls into this first class, a preliminary field examination should be made. The mere fact that an application has been received does not always mean that a sale is possible or advisable. This preliminary examination should be made well in advance of the beginning of actual field work and, if possible, by the man who will have charge of the project.

POINTS TO BE COVERED.

1. The desirability and probability of an immediate sale.
2. That portion of the area which should be covered by reconnaissance.
3. The maps and other data available for present use.
4. The plan of topographic control.
5. The per cent of the area which should be estimated.
6. The size and organization of the party.
7. The equipment needed, transportation facilities, trail construction necessary, possible camp sites, etc.
8. A tentative division of the area into logging units.
9. Deviations, if any, considered advisable from these instructions.

EXTENSIVE RECONNAISSANCE MAP.

If not already in existence, an extensive reconnaissance map should be prepared in connection with the preliminary field examination. On this, much of the above mentioned information can be entered.

PRELIMINARY PLAN.

As the result of this examination the preliminary plan will be prepared in co-operation with the Supervisor by the man examining the

area, for the approval of the District Forester, and should be a solution of the above points under examination. Unless modified by the District Forester in writing, this plan of work will remain in effect until the project is completed. Subsequent projects on the same division or Forest should be carried on as far as possible along similar lines.

DISTRICT OFFICE SUPERVISION.

The preliminary plan will be checked, where considered advisable, by one or more representatives from the District office, including, if possible, the logging engineer, who will ultimately appraise the timber. As soon as practicable after the actual field work has commenced, a representative of the District office will visit the crew to assist in lining up the work and in standardization of methods.

METHOD OF WORK.

The reconnaissance field work is to be done by what is known as the strip system. The principle of this is that parallel strips located at definite intervals are estimated carefully and taken as samples representing the whole area. These strips are usually one chain in width. The distance between strips depends on the character of the timber and varies from one-eighth to one-half mile. While the strips of each series are run parallel to each other, the general direction chosen is that which cuts the drainages most nearly at right angles (as better averages are thus obtained) and at the same time gives the shortest distances between control lines. In surveyed country, however, the cardinal direction most nearly satisfying this condition is chosen. The estimating of the strips is done by crews of two men, consisting of an estimator and a compassman. The data obtained are a tally of each tree standing on the strip by diameter, in inches breast high, and by height, in 16-foot logs. Computation of this data is by means of volume tables which show the average contents in board measure, by species, of trees of each given diameter and height. Since these volume tables are based on sound timber, a deduction must be made for defect if any is present. The estimate for a 40 or other unit is obtained by multiplying the volume of the timber on the strips run within that unit by a "Correction Factor," which represents in the judgment of the estimator the ratio between the timber on the unit and on the strip.

ORGANIZATION.

The standard crew is as follows:

Chief of party.
Draftsman.
Four estimators.
Four compassmen.
Cook, packers, or teamsters, etc., as needed.

The Chief of Party should be a man thoroughly trained in reconnaissance work and of sufficient executive ability to secure accurate and effective work from his crew.

The draftsman should be not only an efficient draftsman, but also sufficiently acquainted with topographic sketching to be able to check and instruct the field men along this line and to adjust intelligently conflicting field sheets. Experience with the transit and other instruments is also a desirable qualification.

The estimators and compassmen should, if possible, have had previous experience or training in reconnaissance. At least 50 per cent should have had previous training in Forest Service reconnaissance crews. A Forest school education is an asset. Previous experience in timber cruising alone, while extremely valuable in the right type of man, is not so great a qualification as a knowledge of reconnaissance methods and a ready adaptability to woods work. This is because in reconnaissance more than a mere cruise of the timber is being secured.

RESPONSIBILITY FOR THE PROJECT.

The Chief of Party is responsible directly to the Forest Supervisor, who, in turn, is, of course, responsible to the District office. While it is often found convenient that the crews be organized by the District office and transferred from Forest to Forest in accordance with the needs of the work, yet each crew, while on a given Forest, should be considered as much a part of that Forest's organization as a crew engaged in any other line of work.

DUTIES OF THE CREW MEMBERS.

Following is a brief summary of the duties of each member of the above listed organization. The details of their work are explained on later pages.

CHIEF OF PARTY.

1. Prepare the preliminary plan.
2. Have direct charge of the personnel of the party; maintain its efficiency; have full authority in consultation with the Supervisor in releasing unsatisfactory men, in hiring and in fixing the rate of pay of temporary employees.
3. Assume direct responsibility to the Supervisor for all work done on the project. This responsibility can be properly assumed only when the Supervisor delegates ample authority to the Chief of Party.
4. Select and train one of the members of the crew as an Assistant Chief of Party to act as Chief of Party in his absence.
5. Delegate authority when necessary to permit himself ample time for acquiring familiarity with the country to be covered, for checking the character of the field work done, etc.
6. Provide for systematic recording and filing of the data collected, so that they can be turned over to a successor, if necessary, for completion.
7. Be responsible for the compilation and final completion of the field data and of the summaries.
8. Submit a brief monthly progress report in duplicate to the Supervisor, the extra copy to be forwarded to the District office.

9. Keep records of the cost of the work and submit cost reports as hereinafter described.

ESTIMATOR.

1. Estimate the timber (Form 494).
2. Note the silvical data (Form 494).
3. Assist the compassman in determining the boundaries of types, age classes and of the merchantable timber, and the density of the stand, and determine the age class by use of the axe where necessary,
4. Assist the compassman by consultation in noting the logging data.
5. Compute the estimate sheets.

COMPASSMAN.

1. Direct the course of the line by compass.
2. Obtain distances by pacing.
3. Obtain elevations by barometer or Abney level.
4. Notify the estimator at the end of each 40 or other unit determined and leave a mark to designate this point, which may be easily picked up by anyone wishing to check the work.
5. Check his line for distance and direction on section corners or established control points.
6. Map in the field the area traversed (Form 493) including topography, culture, types, boundary of the merchantable timber, density of timber or normality.*
7. Note the logging data (Form 493).
8. Assist the estimator by consultation on the silvical data.

DRAFTSMAN.

1. Check, and correct, if necessary, the compassman's field maps.
2. Compile these maps into a base map.
3. Be custodian of the camp property and records.

CONTROL METHODS.

The principles governing the selection of a system of control and the field methods involved in running the control lines are covered in the instructions for topographic survey.

THE ESTIMATE.

The per cent of the area to be covered by the strips depends upon the character of the timber. In timber of small size, where the stand is essentially uniform, where comparatively little underbrush is present, or where the timber is of relatively small value, a 5 per cent estimate is sufficient. Where the timber is large, uneven in distribution, or considerable value, and where underbrush is dense, a 10 per cent estimate is necessary. In extensive areas of grass land, brush, etc., a 2½ per cent estimate is sufficient. A 10 per cent estimate requires two strips

*See Appendix under "Normality Description."

through each 40 or its equivalent; a 5 per cent estimate, one; while for the 2½ per cent two strips through each section or its equivalent is required. In general, 5 per cent is considered standard for the lodgepole region, and for the smaller and more uniform timber of the white pine region, while 10 per cent should be used in most cases in the more valuable white pine stands. The more intensive estimate is also necessary in the case of isolated government forties, surrounded by alienations. The unit of estimate should be the 40 on surveyed ground, while on unsurveyed, the unit should be adopted by the Chief of Party usually on the basis of logging units. On surveyed ground, a single sheet (Form 494) should be used for each 40 except where the 40 lies within two distinct logging units, when separate sheets should be used for each. Similar principles should govern the use of sheets on unsurveyed projects, but timber on not to exceed two acres should be tallied on a single sheet.

ESTIMATE SHEET FORM.

Form 494 should be used for securing the estimate. In the case of surveyed land the township, range, section, forty, and meridian should be entered at the head of each sheet and the 40, with the direction in which the strip or strips are run, also noted by means of an arrow in the block of 16 squares. In unsurveyed areas the location of the sheet should be identified by township and range, if possible, and by such numbers and letters as will clearly correlate the estimate sheets with the draftsman's base map. The initials of the compassman and estimator, and the date should also be entered in the proper space. A vertical column should be used for each species. Use of a miscellaneous column should be avoided. The horizontal columns should be numbered by one-inch classes in the lodgepole region and by two-inch classes in the white pine region. The minimum diameter to be estimated is 8 inches. The tallying of the trees is by numbers expressing their height in merchantable logs, i. e., a 4 entered in the vertical column headed "White Pine," and in the horizontal column headed headed "20" represents the white pine tree 4 logs in height and 20 inches in diameter. In case the number of trees to be tallied is so great that the space for a given size will obviously be insufficient, a condensed form of tally is made possible by the use of the dot system, following the number or numbers expressing the height. In tallying, the d. b. h. (diameter breasthigh) is obtained by ocular estimate, checking the eye frequently by the Biltmore stick (or diameter tape or calipers, if Biltmore sticks are not available.) The height of the trees is obtained by ocular estimate, checking the eye by pacing windfalls wherever available and by the use of the hypsometer, if not. The width of the strip should be frequently checked by pacing out to doubtful trees. In types where a large number of unmerchantable trees are present (as in the case of white pine with its defective cedar, hemlock and white fir) a column should be reserved for a tally of these unmerchantable trees. A column should be also used for any special products present. In a cedar pole column, for example, the d. b. h. figures should be disregarded and the column should be divided into four parts headed respectively "25 feet," "30 and 35 feet," "40 and 45 feet," and "50 and 55 feet." A column for cedar logs is usually necessary to take care of the butts of trees from which a pole can be secured from the tops. The logs should be tallied by top diameter

opposite the proper figure of the d. b. h. column. A column for ties may be used where considered advisable, but the use of the regular form of tally supplemented by tie volume tables when separate tie estimates are advisable, is preferable.

CULL.

Since the volume tables are prepared on the basis of sound trees, it is necessary to estimate the percentage of the cull for each species found on the strip. Defect of all sorts should be entirely handled by this method rather than by reducing the diameter or the height of individual trees tallied. The cull figures estimated for each species should be entered on Form 494. Trees which are absolutely unmerchantable should be tallied in an unmerchantable tree column and the cull factors therefore need not take these into consideration. In the case of very defective species, as hemlock and white fir, where practicable, a separate tally should be made of apparently sound and unsound merchantable trees.

CORRECTION FACTOR.

The correction factor is the figure by which the estimate for the strip or strips within a given 40 or other unit must be multiplied to give the estimate for the whole unit. It is usually obtained by dividing the acreage of the timbered area within the unit by the acreage of the timbered area upon the strip or strips. If the unit is solidly timbered, the correction factor in the case of a 10 per cent estimate is ordinarily 10 and of the 5 per cent estimate, 20. A further discussion of less obvious cases is to be found in the appendix.

COMPUTATIONS.

Each estimator may be held responsible for the computation of his estimate sheets, or such other arrangement made for handling this part of the work as seems best to the Chief of Party. The volume of each size of tree tallied is obtained from the proper volume table and multiplied by the number of trees of that size as shown by the tally sheet. This step in the operation may be eliminated by the use of the multiple volume tables given in the appendix. An addition of each species column separately gives the "Volume on strip" of that species. This figure should be entered in the proper space at the bottom of Form 494. These figures are then reduced by multiplying by one minus the cull per cent, the result being the "Volume on strip net." Multiplication by the correction factor then gives the "Volume on 40."

The column for cedar poles is merely totaled by height classes and the column for cedar logs is handled similarly to the regular species estimates, using the Scribner Log Rule in place of a volume table. The number of logs and the number of trees by species is obtained by a simple count and entered in the appropriate spaces: ("Logs No." and "Trees No."); the "Logs per tree" results from dividing the number of logs by number of trees, and the "logs per M" from dividing the number of logs by the "Vol. on strip net." The "Volume to cut" need not be calculated by the reconnaissance men, but may be filled in, if desired, by the Supervisor. (Omit if this heading is eliminated from the form).

The heading on the back of this Form, **"Location of Timber,"** should be used to indicate any conditions covered by this heading not satisfactorily shown by the map. Notes such as "all cedar is within 2 rods of creek" or "80% of white pine is on north slope" are of immense value, and should be freely entered.

THE SILVICAL DATA.

The purpose of the silvical data notes is a description of the timber and of the site from the standpoint of silviculture. Its use is primarily to aid in determining the advisability of a sale and the silvicultural method applicable.

The silvical data which is to be noted is indicated by the headings on the back of Form 494. Observations should be made constantly while passing through the 40, and entries should be made before leaving it. If two strips are taken in a given 40, the entry should be made at the end of the first strip and these entries should be checked at the end of the second, any differences found being noted. The use of initials E. and W. (east and west) and N. and S. may be used to indicate varying conditions on the two strips.

The conditions of the stand is described by the use of one of the three words. thrifty, mature or decadent. Mature timber is that which has passed the point of rapid growth, but has not yet commenced to retrogade. In general, the age of mature timber is from 120 to 160 years. The words thrifty and decadent are sufficiently limited by this definition of the word mature.

Notes on **damage** include that by fire, by insects and by other agencies. The points to be noted are sufficiently indicated on the Form.

The average **clear length** of the timber should be noted for each species in 16' logs and half logs. By "clear length" is meant that portion of the bole of the tree which is practically free from branches, live or dead, and is not included in the crown.

Under **"Reproduction"** on the back of Form 494 is included only that reproduction which is of importance from the standpoint of future timber crops. Young hemlock, white fir, for example, standing beneath mature white pine, will undoubtedly be largely destroyed in logging and is not here to be considered. Such worthless reproduction is treated merely as "brush" under logging factors. The notes to be taken on young stands, and on the young individuals in these selection stands are fully indicated by the headings on the Form.

Soil is described by composition, degree of moisture and depth. The word **loam** should be used to indicate any mixture of sand and clay, silt and clay, or either sand, clay or silt with humus which results in the crumbly consistency commonly indicated by this term. By **silt** is meant siliceous material so pulverized as to have no gritty feeling; that is, it is simply an exceedingly fine sand. It lacks the characteristic odor of clay and will not remain in suspension in still water more than a few hours. Silt is not necessarily confined to alluvial deposits, although there is its most common occurrence. **Sand, clay** and **gravel** need no definition. By **fresh** soil is meant soil containing sufficient moisture to be damp to the touch, but not sufficient so that drops can be expelled by pressure of the hand. **Moist** and **dry** are sufficiently limited by this definition of the word **fresh.**

By soil of moderate depth is meant that between six inches and two feet, with the words **shallow** and **deep** limited accordingly.

Under the heading **"Rock"** should be entered the character of the underlying formation if it can be determined, as granite, shale, limestone, etc.

Under **undergrowth** should be entered (1) the species in their order of abundance; (2), the density of the patches of brush, etc., as **open, medium** or **close,** and (3), the percentage of area covered by the patches.

Type, age class and density or normality, although indicated only on the map, are strictly silvical characteristics, and it should be the estimator's duty to keep these factors in mind and to assist the compassman in making the proper entries on his map.

THE FIELD MAP.

The field map should be made on Form 493, using the scale 4 inches to the mile to which this Form is adapted.

On this map should be entered topography and culture in accordance with the instructions for topographic work. **Types** and **age classes** and the density or the normality of the stand should also be indicated. The type and age class is of importance from the standpoint of marking which in turn directly influences the stumpage value, and also from the standpoint of yield studies. Density figures are chiefly of descriptive value. The boundaries of these types, etc., should be indicated by dotted lines and within each boundary symbols expressing the type, age, class and density or normality should be entered. The minimum area to be distinguished as a separate type or age class is 5 acres. Smaller areas, however, which are important by reason of special features of topography or culture, such as small bodies of water, swamps, and barren or grass patches occurring in great contrast to the surrounding area, should be shown on the map. In the appendix can be found a definition of the types and the symbols used to indicate each. The boundary of the merchantable timber should also be determined as closely as possible by the crew, and checked by the Chief of Party. When at all practicable this work will be checked by the appraiser during an early part of the field work. This may be indicated on the map by the following symbol: —. N. M. —. M. —. Unless the line is very distinct and certain, the estimate should always be carried some little distance into the unmerchantable area. It is usually sufficient to merely complete the "40." For definitions of types and age classes see Appendix (Pg.). In estimating crown density in a given case, the part of the total canopy space normally occupied by a full stand which is occupied by trees of all species whether merchantable or unmerchantable, of the same general age class, is designated by a figure—1 to 10; 10 representing a full stand. In the case of a broken stand with the vacant spaces stocked with seedlings, the density figure will apply to the older stand and not to the reproduction.

LOGGING DATA.

The purpose of the notes described under the term "Logging Data" is a description of the surface conditions of each unit from the stand-

point of logging. These notes should be secured even if there is no merchantable timber at the present time upon the unit, since it is probable either that merchantable timber upon other areas may have to be removed across this unit or that at some future date logging operations will have to be planned on the basis of the present notes. This data is noted on the back of Form 494. For the purpose of description, the area is divided into three heads: general surface, major, and minor transportation routes. The general surface is what affects the cost of logging in place, including felling, swamping, brush disposal, skidding, etc. The minor transportation factors influence such operations as chuting. The major transportation factors bear upon the feasibility of road construction, flume building, etc. Notes are also taken on streams and stream flow from the standpoint of fluming and driving.

Under each main division the various factors to be considered are entered on the sheet. Beneath each factor are two or more description terms. Beneath each of these terms is a block of 16 small rectangles which correspond by location with the 16 forties of the Section map on the front of the sheet. The notes are taken by entering a check mark in the proper rectangle beneath the proper term. If it is desirable to distinguish between the east and west or north and south part of a 40, the initials E. and W., etc., can be appropriately entered.

Under such headings as "Rock" where the space available does not permit an adequate description, numerals can be entered which refer to references made on the blank lines on the bottom of the sheet.

The stream flow in cubic feet per second need be taken only at the lowest point at which a main stream or any of its forks is crossed by any strip.

TRAINING OF CREW.

It is essential that each crew be thoroughly trained in every detail of the work of a given project before the data secured shall be considered reliable. Such training is necessary in spite of previous experience which the crew members may have had and alone can insure the desired degree of accuracy and uniformity in the data secured. In such training it is necessary for the Chief of Party to spend more or less time in the field with the crew as a whole and with each member of the crew separately in the practice of each detail of the work. It must be assured, that is, not only that the estimate is accurate, but that each member of the crew means the same thing when he states that the underbrush is moderate in density, etc. As complete a standardization as is possible **within** each crew of the terms used is of far more importance than standardization between crews working on different forests. It is, however, desirable that as nearly as possible the same standards be used for all work done on a given forest, even if covering a period of years. This can only be accomplished by the Forest Supervisor keeping in close touch with the work of each crew which may be assigned to him.

CHECKING.

Two forms of checks are possible; a check of the method used and a check of the men themselves. The former can best be obtained by having men who through experience are considered absolutely reliable and accurate judges of timber cruise 40's already covered by reconnaissance.

Since, however, the methods described in these instructions have been given thorough trial, this form of check can usually be omitted. The second form is much more important, as it serves an additional purpose in instructing the men and raising their standards of accuracy. Details of a method which has been found of considerable value are given in the Appendix. The results of all checks made should be included in the Monthly Progress Report.

SUMMARIES.

The field data gathered by a reconnaissance crew is so voluminous that it is of little value unless carefully summarized. The responsibility for this summation rests on the Chief of Party. Separate summaries of the four classes of data above described should be made, preferably by logging units. The form which each should take follows:

1. **Estimate Data**—The summary of the estimates can be most conveniently put in the form of a tabulation. For this tabulation the estimates for each logging unit will be transferred from the 40 sheets involved to a summary sheet for this unit. For each probable timber sale chance the summary sheets of the logging units involved will in turn be summarized for that chance by type and age class as explained in the Appendix. On certain areas where the proportion of very small or very large timber (such as 40 per cent of the white pine on a given chance being over 30 inches d. b. h.) can be anticipated as a factor in making the appraisal and sale, these sizes should be separately summarized from the start, and each 40 sheet computed with this in mind. Not only the total stand but also the logs per tree and per M. and the cull per cent should be shown. The average acre should also be given by logging units. Notes on the young growth, while strictly a portion of the estimate, can best be handled by including them under silvical data. For sample summary see Appendix page.

2. **Silvical Data**—The summary of the notes on silvical data should take the form of a concise, but precise description of the logging unit from the standpoint of each heading on Form 494. In addition the silvical data from the map should be calculated and stated, including such information as the area within each type and age class, the density figures, etc. For sample summary see Appendix page.

3. **Map Data**—The base map is the only summary of the map data which is necessary. Full instructions for compiling this are given in the instructions for topographic mapping. This base map should be kept strictly up to date. Adjustments of type lines, etc., where the field sheets of two different compassmen disagree should be made immediately, while both men still have a definite recollection of the area.

4. **Logging Data**—The summary of the notes on logging data should take the form of a brief description of each logging unit from the standpoint of the headings on the back of the Form 493. The description can often be best made by means of rough percentages. For sample form of summary, see Appendix page.

In addition to the above summaries for the logging units, additional summaries should be made for each major drainage covered by a specific project. Further summaries by divisions or for the forest as a whole are not to be made by the reconnaissance parties, but can be compiled, if thought desirable, by the Supervisor.

EMPIRICAL YIELD TABLE DATA.

Data on yield is essential in the prediction of future growth, so that in the preparation of the working plan for the management of the Forest it is quite as essential that yield data be collected as that a reconnaissance of the present resources of the Forest be made.

The summarization of estimate data by type and age class as outlined in these instructions will make all such data collected available for empirical yield studies. It is therefore very important that the several age classes be accurately mapped and continual use of the ax for making age determinations will be necessary.

APPRAISAL OF TIMBER.

The appraisal of the timber examined is not a part of the duties of the reconnaissance crew. Figures on the cost of logging can best be collected by competent logging engineers after the reconnaissance data is summarized.

MONTHLY PROGRESS REPORT.

At the end of each month the Chief of Party should submit a progress report in duplicate to the Supervisor; the original being forwarded by the latter to the District office. This report should be a concise statement of the progress made and should mention any unusual features of the work or unexpected problems met. It should also contain the results of the check estimates made during the month.

MISCELLANEOUS.

All equipment should be obtained through the Supervisor's office in the usual manner. The District office endeavors to keep on hand, however, a small supply of barometers, compasses and similar instruments so that in case of emergency time may be saved by wiring to Missoula for additional equipment needed. In the Appendix will be found lists of the necessary equipment for the standard crew.

In certain instances modifications from the form of reconnaissance herein described may be desirable. These should be adopted by members of the party only with the consent of the Chief who should restrict them to unusual instances. Methods which are authorized in such emergencies are described in the Appendix.

Cost-keeping records should be carefully kept. The forms which should be used are given in the Appendix. Copies may be obtained from the District office. The nature of the cost records and the detail in which the figures are desired are definitely indicated by these forms.

The original field data should in all cases be considered as a permanent record and should be filed in the Supervisor's office.

APPENDIX

CRUISER STICK.

The Forest Service Cruiser Stick has four sides: (1) Biltmore stick, (2) Merritt hypsometer, (3) Scribner Decimal C scale for 16-foot logs, (4) inch scale. The last two are for convenience in finding the approximate contents of fallen trees. Detailed instructions for the construction and use of the Biltmore stick and Merritt hypsometer follow:

BILTMORE STICK.

To use the Biltmore stick, the observer holds it in his right hand horizontally against the tree 4½ feet (breasthigh) from the ground, and 25 inches from his eye, which should be on a level with the stick. If necessary the head should be lowered till the eye is at the proper height. The distance from the tree can be measured by placing the zero end of the stick against the tree and holding the eye at the 25-inch point marked on the back of the stick.

FORM AND CONSTRUCTION.

In the absence of the standard Cruiser stick a Biltmore stick may easily be made. It should be similar to a scale stick in both material and size, except that its length need be only 36 inches or less, if intended for trees 60 inches or less in diameter. Three methods of graduation are possible.

1. One edge may be beveled and the graduations entered on this edge.

2. The edges may be left square and the graduations entered on the broad faces.

3. The edges may be left square and the graduations entered on the broad faces as lines radiating from a series of points representing the successive positions of the eye for trees of various diameters. Center lines corresponding to each radial line should also be entered crossing the stick at right angles. A stick of this pattern should be held with its edge rather than its flat surface against the tree. The radiating lines are useful to a certain extent in keeping the eye at the proper distance.

In either case it is helpful to enter the arm length on the narrow edge.

FORMULAE.

(A) $S = \sqrt{\frac{d^2\ a}{a + d}}$ (B) $S = \frac{d(a - t)}{a\sqrt{(a + d)}}$

Where S = Graduation distance on stick.
d = Diameter of tree.
a = Arm length or distance stick is to be held from eye.
t = Thickness of stick.

Formula A is to be used for patterns of sticks which are so arranged that the graduations are in a line strictly tangent to the tree. This is true in the construction described in 1 and 3 above. In construction 2 the visible graduations are separated from the tree by the thickness of the stick and Formula B should be used.

TABLE.

Diameter. breast high (d)	Distance (a) from eye to tree—Inches.									
	23		24		25		26		27	
Inches	Actual distances (s) in inches to be marked on stick.									
	A.	B.	A.	B.	A.	B.	A.	B.	A.	B.
6	5.34	5.29	5.37	5.31	5.39	5.34	5.41	5.36	5.43	5.38
8	6.89	6.82	6.93	6.85	6.96	6.90	7.00	6.93	7.03	6.96
10	8.35	8.26	8.40	8.31	8.45	8.36	8.50	8.41	8.54	8.46
12	9.73	9.67	9.80	9.69	9.86	9.76	9.93	9.83	9.99	9.89
14	11.03	10.02	11.13	11.01	11.21	11.09	11.29	11.17	11.37	11.25
16	12.29	12.15	12.40	12.26	12.50	12.36	12.59	12.46	12.68	12.56
18	13.49	13.34	13.61	13.47	13.73	13.59	13.84	13.70	13.95	13.81
20	14.63	14.46	14.77	14.61	14.91	14.75	15.04	14.89	15.16	15.02
22	15.72	15.55	15.89	15.72	16.05	15.89	16.19	16.05	16.34	16.19
24	16.79	16.60	16.97	16.79	17.14	16.95	17.30	17.11	17.46	17.30
26	17.81	17.62	18.01	17.82	18.20	17.99	18.38	18.20	18.55	18.38
28	18.80	18.59	19.02	18.82	19.23	19.04	19.43	19.24	19.62	19.44
30	19.76	19.55	20.00	19.79	20.22	20.02	20.44	20.24	20.65	20.46
32	20.69	20.47	20.95	20.72	21.19	20.97	21.42	21.21	21.65	21.45
34	21.59	21.36	21.86	21.64	22.13	21.91	22.38	22.16	22.63	22.42
36	22.47	22.23	22.76	22.52	23.04	22.81	23.30	23.08	23.56	23.35
38	23.32	23.07	23.64	23.38	23.94	23.69	24.23	23.99	24.49	24.27
40	24.17	23.91	24.49	24.24	24.80	24.56	25.10	24.86	25.40	25.16
42	24.98	24.71	25.32	25.05	25.65	25.38	25.96	25.71	26.27	26.03
44	25.78	25.50	26.13	25.87	26.48	26.23	26.81	26.55	27.13	26.89
46	26.55	26.26	26.93	26.65	27.29	27.01	27.64	27.36	27.89	27.72
48	27.31	27.01	27.71	27.41	28.09	27.80	28.46	28.17	28.80	28.54
50	28.07	27.76	28.48	28.18	28.86	28.57	29.24	28.96	29.61	29.34
52	28.79	28.48	29.22	28.91	29.63	29.32	30.02	29.72	30.40	30.11
54	29.51	29.18	29.95	29.63	30.38	30.06	30.79	30.48	31.18	30.89
56	30.22	29.88	31.11	30.35	31.53	30.79	31.94	31.22	32.33	31.64
58	30.90	30.56	31.38	31.04	31.83	31.49	32.27	31.94	32.69	32.38
60	31.58	31.23	32.07	31.73	32.54	32.20	33.00	32.67	33.43	33.12

Values headed "A" and "B" are calculated from the formulae correspondingly lettered. In B "t" is assumed as ¼ inch.

CORRECTIONS IN USE.

For absolute accuracy the following conditions must be fulfilled. The tree must be circular in cross section; the stick must be held against the tree at a point 4½ feet from the ground; the stick must be horizontal; the line of sight from the eye to the stick at the point of contact with the tree must be perpendicular to the axis of the tree, i. e., horizontal if the tree does not lean; the stick must be perpendicular to this line of sight; the eye must be at the proper distance from the tree. If any of these conditions are not strictly fulfilled an error will result. The various sources of error are not, however, of equal importance. The following table will show how serious a variation from the above named conditions will produce an error of 1% in diameter for 10 inch, 30 inch and 60 inch trees; also the direction of the error:

Sign	Cause	Resulting in error of 1% in Diameter D. B. H. of Trees.		
		10"	30"	60"
—	Eye above or below stick by.....	9.2"	7.3"	7.1"
+	Stick not horizontal—one end higher than other by.....	4.6"	4.2"	4.1"
+	Stick not perpendicular to line of sight—one end nearer the eye than the other by.....	4.9"	4.9"	5.1"
±	Eye too near to or too far from tree by	1.4"	.45"	.65"

The error resulting from taking the measurement at a point which is too high or too low varies of course greatly with the species and form of the tree. In general, however, it will be negative owing to the inconvenience of stooping to the proper height. The above table shows conclusively that the only dangerous source of error is in the distance of the eye from the tree. Fortunately, this is apt to be more or less compensating. Furthermore, the errors constant in sign may offset each other to a certain degree.

It should be further noted, however, that particular care should be taken in the case of irregular trees. Measurements of a smaller diameter will be reduced and of a larger diameter will be increased by use of the Biltmore stick. This exaggeration of the errors of the caliper in this case makes it particularly important that either two measurements, or a measurement of an average diameter be taken where an accurate measurement of a single tree is desired.

MERRITT HYPSOMETER.

The Merritt Hypsometer is designed for measuring height in 16.3-foot logs at two different distances from the tree, namely, 1 chain and 1½ chains. It is used as follows:

(1.) Pace a distance of one chain, or a chain and a half, measured horizontally, from the tree.

(2.) Hold the stick vertically, squarely in front of the eye, and as nearly plumb as possible. After some practice it can be plumbed with a fair degree of accuracy by holding at the lower end and balancing: if the tree is downhill it can sometimes be held near the upper end and plumbed by its own weight. The hypsometer side should be at right angles to the observer's line of sight.

(3.) Raise or lower the stick until its lower end, or any convenient mark for the proper distance, intersects stump height on the tree.

(4.) Holding it in this position, read on the proper scale the distance intersected by the top of the last log. If the observer is at one chain from the tree the height will be shown by the left hand scale, or large figures, if at one and a half chains, by the right hand scale, or small figures.

Height may be measured with this hypsometer on the level or on any slope, either above or below the tree, provided the distance from the observer to the tree is the horizontal distance. For very tall trees, double the distance will give double the number of logs.

Any straight stick may readily be made into a Merritt hypsometer. The following table gives measurements to be used for the different reach intervals.

For use one chain from tree.		For use 1½ chains from tree
Distance from eye to stick.	Interval on stick for measuring one log (16.3') on tree.	Interval on stick for measuring one log (16.3') on tree.
23"	5.68"	3.78"
24"	5.93"	3.95"
25"	6.18"	4.11'
26"	6.42"	4.27"
27"	6.67"	4.44"

CHECKING.

The importance of an adequate checking system can hardly be overemphasized, particularly in the case of less experienced men. The method often employed formerly, of handling this question by having some lumberman cruise occasional forties after the reconnaissance, has seldom proven entirely satisfactory, since even at best, this system merely measures the error without determining its cause.

SYSTEM FOR ANALYSIS.

The following system has been tried with considerable success, and has the advantage of giving an analysis of each man's errors as well as determining their amount. One of the most experienced estimators is chosen as a check estimator. This man, with a compassman, re-runs forties already covered by the various estimators. In every detail his work is identical with the regular reconnaissance work, except that he works very slowly and with maximum accuracy. All diameters are actually measured by Biltmore stick or calipers; the width of strip is paced out in all cases of doubt, and heights are constantly checked by measuring wind-fall or by hypsometer. Furthermore, the strips are run as nearly as possible over exactly the same ground as that covered by the original estimate, a mark being left at the end of each forty by the original compassman.

A comparative analysis is then made of the original sheet and of the check sheet on some such form as follows:

SAMPLE ANALYSIS SHEET—CHECK ESTIMATE

NE¼ SW¼, S. 13, T. 50, N. R. 4E. B. M.

Esimator, J. Smith

Species	Estimate	Check	Error	Pct. Error
W. Pine	298 M	260 M	-38 M	-14.6
D. Fir	56 M	49 M	- 7 M	-14.3
Total - -	354 M	309 M	-45 M	-14.5

White Pine

Diam. Group	No. of Trees		No. of Logs		Logs per Tree	
	Est.	Check	Est.	Check	Est.	Check
15" and over	33	31	59	68	2.1	2.2
16" -20"	20	21	82	84	4.1	4.0
21" -25"	6	5	35	29	5.8	5.8
26" -30"	3	2	24	15	8.0	7.5
30" -	1	2	9	16	9.0	8.0
Total -	63	61				

Douglas Fir

Diam. Group	No. of Trees		No. of Logs		Logs per Tree	
	Est.	Check	Est.	Check	Est.	Check
15" and over	20	18	56	50	2.8	2.8
16" -20"	17	20	76	89	4.5	4.4
21" -25"	10	8	60	49	6.0	6.1
26" -30"	6	7	51	56	8.5	8
30" -	3	3	29	24	9.7	8
Total	56	56				

Comment.

This check indicates:

Width of strip, O. K.
Diameter, O. K.
Height O. K. up to about 25 inches, **for larger trees too high.**

8-16-12 H. JONES, Check Estimator.

APPLICATION OF SYSTEM.

Checks should be made at intervals depending on the experience of the crew. During the first two or three weeks after the training periods the check estimator should be kept continually at this work. Later, he may be used for the greater part of the time in routine estimating. Time may be saved by selecting for checking two forties cruised by different estimators which lie adjacent. The speed of check estimating, (including the analysis work), is about one-half that of the regular estimating work. Silvical data, logging data, cull per cents, etc., should be checked at the same time with the estimate and the compassman accompanying the check estimator should check for topographic detail.

CORRECTION FACTOR.

The application of a correction factor based upon the estimator's general impression that the strips run are a certain per cent above or

below the general average of the 40, is very dangerous except in the case of the most experienced men. Even the more inexperienced estimators, however, can use it with advantage when its determination is arbitrary and mathematical, as in the following cases:

1. When the timbered area of a forty is broken by parks, burns, and other openings, the correction factor is the direct ratio between the timbered area in the forty and the timbered area covered by the estimate strip or strips

2. When different types containing nearly pure stands are traversed by the estimate strip, but when it is evident that the strip does not include an area within each type proportionate to the acreage of the type, the correction factor may be calculated in a manner similar to 1, separately for each species.

3. When the compassman makes gross errors in pacing the correction factor may be mathematically adjusted to compensate

Example 1: The compassman's map shows that 11 acres of a forty are grassland and 29 acres timbered, and that 15 chains of the double strip was run in the grassland and 25 chains in the timbered; timber area within strip 2.5 acres.

$$\text{Correction factor.} \quad \frac{\text{Acreage timber on forty}}{\text{Acreage timber on strip}} \quad \frac{29}{2.5} = 11.6$$

Example 2: The compassman's map shows that 5 acres of the forty is spruce type and 35 acres is lodgepole pine type, and that 8 chains of the single strip run was in spruce, and 12 chains in lodgepole pine. Area of spruce type in strip .8 acres; area of lodgepole pine type in strip 1.2 acres; correction factor spruce $= \frac{5}{.8} = 6.2$; correction factor lodge pole pine $= \frac{35}{1.2} = 29.2$

Example 3: A compassman falls 5 chains short of the section line on the far side of a section covered. The estimator tallies on through to the line. Obviously, the sheet for the last forty run contains too much timber at the expense of the first three forties Assuming the error in pacing to be equally distributed, we have 85 of the compassman's chains equal to 80 true chains. Each of the first three sheets then covers $\frac{80x20}{85}$ chains in length and the last is $\frac{80x(20+5)}{85}$ chains in length.

Area of strip first 3 forties $= \frac{85}{80x2}$

Area of strip last forty $= \frac{85}{80x2.5}$

Correction factor (in case of one strip to forty) $= \frac{40}{\frac{80x2}{85}} = 21.3$ for first 3 forties, and $\frac{40}{\frac{80x2.5}{85}} = 17.0$ for last forty.

In case two strips are run to the forty the actual area of each strip should be calculated separately and the two added, the sum being divided into 40. The following table gives the area of the sample strips in each of the first three and the last 40 in the case of various errors in pacing:

Chains paced per mile	Acres in each of first three 40's	Acres in last 40
90	1.75	2.62
89	1.77	2.57
88	1.80	2.52
87	1.83	2.46
86	1.85	2.40
85	1.87	2.34
84	1.90	2.28
83	1.93	2.21
82	1.95	2.14
81	1.97	2.07
80	2.00	2.00
79	2.03	1.92
78	2.05	1.84
77	2.07	1.76
76	2.10	1.68
75	2.13	1.59
74	2.15	1.50
73	2.17	1.41
72	2.20	1.32
71	2.23	1.22
70	2.25	1.12

COST KEEPING SYSTEM AND FORMS.

The following special forms will be used for cost keeping on reconnaissance projects. These may be requisitioned from the District Office. In addition to these the standard Form 21 may be kept in the field. This will be totaled at the end of each month, and the food supplies on hand will be entered in red ink and deducted, a similar amount being carried forward to the next month. The special forms should be totaled and completed as soon as possible after the end of each month and filed in the Supervisor's office, a copy of the final summary sheet for the month only being forwarded to the District office.

CULL.

Cull is a very difficult matter for inexperienced men to handle. They may be largely assisted by the preparation of a table showing the average maximum and minimum cull per cent characteristic of a given region for each species, further divided by site, etc., if necessary. This table should be prepared from the best available information. An observant scaler who has worked in the region in question is probably best qualified to prepare it. The following table which was used on the Coeur d'Alene Forest will indicate the form such data may take.

FLAT.

	Average Cull.					
	White Pine	*Hemlock	Tamarack	*White Fir	Red Fir	Spruce	Cedar
Extreme maximum	65	100	35	85	25	25	60
Average maximum	30	50	20	45	10	10	40
Average minimum	10	30	10	25	5	5	15
Extreme minimum	5	20	5	15	0	0	0

SLOPE.

Extreme maximum	35	50	20	40	20	20	20
Average maximum	15	30	15	30	10	10	10
Average minimum	8	20	7	20	5	5	0
Extreme minimum	3	10	0	10	0	0	0

These cull per cents include both breakage and defects

*Trees obviously defective not tallied.

DESCRIPTIONS OF TYPES.

Following are the descriptions of the types for which symbols are given in the instructions. In these descriptions the percentages given are percentages of the numerical proportion of the trees and not of the volume. The trees considered for this numerical proportion should in mature stands include all age classes which have definitely established themselves as a part of the stand and which therefore indicate its type. Ordinarily this will include pole and sapling growth but not seedlings.

The classification hereafter outlined is based upon the present composition of the stand, regardless of whether this composition is the ultimate cover of the site or merely a temporary cover resulting from some interference with natural conditions. Where a succession of types is known to occur, either the ultimate type, or one of the stages in the succession which, as far as can now be foreseen, will be perpetuated in forest management, may, if desired, be mapped or used for purposes of management in addition to the present cover.

TREELESS LAND.

There is no clear line of demarcation between trees and shrubs, and in this classification, which is purely for practical purposes, no attempt is made to draw a fine distinction between them. Accordingly, under "Treeless Land" are included two types, "Brush" and "Sagebrush," which are often composed partly or entirely of individuals having tree form, but so small and stunted that the types in which they occur are ordinarily classed as treeless.

Barren—An area too rocky, too exposed, too arid, or at too high an elevation to support trees or grass or more than a very scattering

growth of herbs and shrubs; and temporary barrens, areas repeatedly burned containing neither reproduction, grass, nor brush in appreciable quantities.

Grass—An area such as parks and mountain meadows, whose principal vegetation is grass and other herbs.

Cultivated—An area now under cultivation or lying fallow.

Sagebrush—An area whose principal vegetation is sagebrush.

Brush—All other areas the present cover of which is a stand of shrubs or stunted trees.

WOODLAND.

An area, usually at the lower altitudinal limits of tree growth, whose crop when mature is a stand of trees, ordinarily open, usually short, branchy, and crooked, most of which are fit only for cordwood, fencing, etc.

Juniper—A stand composed of approximately 80 per cent or more of any species of juniper, with very little or no pinion. Rocky mountain juniper is the chief species, usually with some limber pine, Western yellow pine, or Douglas fir.

TIMBERLAND.

An area whose crop when mature is a more or less dense stand of trees which may furnish sawlogs, ties, telegraph poles, etc.

Yellow Pine—A stand containing approximately 50 per cent or more of Western yellow pine. Usually on dry well-drained sites at the lower altitudinal limit of timberland or exposed south and southwest slopes at higher altitudes. The principal species in mixture are Douglas fir, Western larch, and lodgepole pine.

Western White Pine—A stand in which Western white pine is the key tree, forming approximately 15 per cent or more of the stand. In the northern part of the range of this type, at medium elevations, hemlock is the predominant tree, frequently outnumbering the white pine even in young stands; at higher elevations in the same region Engelmann spruce and Alpine fir are the chief associates. In the middle of its range white pine occurs nearly pure or with Douglas fir as its chief associate, and with hemlock, white fir, larch and sometimes lodgepole pine in mixture. In the southern part of the range of this type white pine is less important numerically than further north. Here in young stands white pine occasionally forms as much as 50 per cent of the stand or more, but usually the predominant trees of the type are white fir and cedar, with Douglas fir and larch in mixture, a little yellow pine on the drier knolls, and sometimes in young stands lodgepole pine.

Cedar-White Fir—The stand is composed of cedar and white or grand fir, the former nearly pure in patches, the latter predominant throughout with a considerable amount of Douglas fir, some yellow pine in groups on the knolls and as scattered individuals throughout and rare Western white pine individuals. The type occurs on the Selway and southern portion of the Clearwater National Forest south of the commercial range of white pine

Cedar-Hemlock-White Fir—Stands composed of cedar, hemlock and white or grand fir in varying proportions, with a little white pine, also Engelmann spruce, Alpine fir and rarely Douglas fir, areas which under management could be made to produce white pine in commercial quantities.

Lodgepole Pine—A stand containing approximately 50 per cent or more of lodgepole pine, usually nearly pure, but sometimes in mixture with other species. The principal species in mixture are Douglas fir, Engelmann spruce, Alpine fir and Western larch.

Douglas Fir—A stand containing approximately 60 per cent or more of Douglas fir, sometimes follows a temporary type of aspen. The principal species in mixture are yellow pine, lodgepole pine and Western larch. Usually at the lower or medium altitudes either at the lower limit of timberland or just above the yellow pine type. Occurs also on north slopes above the white pine type.

Larch-Douglas Fir—A stand containing approximately 60 per cent or more of Western larch and Douglas fir, with white or grand fir in mixture. Larch is the key tree. The proportion of larch varies greatly from very little to practically pure. The principal species in mixture is yellow pine, but occasionally with lodgepole pine, Western white pine, lowland fir, Western red cedar, or Western hemlock. Usually at medium elevations about the same as Douglas fir, but with more favorable site conditions. On less favorable sites than white pine.

Engelmann Spruce—A stand containing approximately 50 per cent or more of Engelmann spruce. Sometimes follows a temporary type of aspen. Engelmann spruce may be pure, but is more often in mixture with Alpine fir, lodgepole pine, limber pine and Douglas fir. Usually at the higher elevations and on the more moist sites.

Mountain Hemlock—A stand containing approximately 50 per cent or more of mountain hemlock (**T. mertensiana**). The principal species in mixture are Alpine fir, Engelmann spruce and Western white pine. Other species common in the mixture are whitebark pine, lodgepole pine, Alpine larch (**L. lyallii**) amabilis fir and Shasta fir. At the higher elevations usually near the upper limit of tree growth, areas of mountain hemlock not capable of producing merchantable stands should be included in the subalpine type.

Subalpine—A stand containing a varying mixture of subalpine species no one of which is abundant enough to throw the stand into any of the types already described or rarely pure stands. At the upper limit of tree growth, usually unmerchantable because of poor form and small size, and of value for protective purposes only. The principal species are Alpine fir, Engelmann spruce, lodgepole pine, white-bark pine, limber pine, mountain hemlock, and Alpine larch.

Legend—In designating land types, land classification, forest types, age classes and cut-over lands on the base map prepared by the field draftsman, symbols as given below will be used. In the preparation of land type, land class, forest type, age class, stand class and other maps to meet a specific need or for the administration of a particular phase of Forest business colors as given below will be used. The latter maps will be prepared on reproductions made by the District office from the base map. Size of areas to be shown on map as separate type covered under Map Data.

Standard Legends. (Using Color Tints).

Date of Origin	Tint No.	Classification and Stand. Maps (Atlas Legend)	Timber Type Maps	Timber Age-Class Maps
	2	Grassland	Grassland (G)	Grassland
1891-1910	10	New burn	Juniper (J)	2-21 yrs. (20)
1711-1750	15	Light 10-25 MBF	Yellow Pine (YP)	162-201 yrs. (200)
Prior to 1711		Dark 25-50 MBF		Over 200 yrs. (200+)
	Indigo	Special	Mountain Hemlock (MH)	Special
1871-1890	23	Special	Cedar-white fir (C-WF)	22-41 yrs. (40)
	5	Special	Cedar-hemlock-White-fir (C-H-WF)	Special
1751-1790	29	Light 2-5 MBF Dark 5-10 MBF	Douglas Fir (DF)	122-161 yrs. (160)
	37	Sage Brush	Sage Brush (SB)	Sage Brush
	46	Cultivated Land	Cultivated Land (C)	Cultivated Land
1911-1930	58	Water	Engelmann Spruce (ES)	Present and next decade (O)
1851-1870	62	Mineral Land	Larch-Douglas Fir (L-DF)	42-61 yrs. (60)
1811-1830	63	Woodland, poles, etc.	Lodgepole pine (LP)	82-101 yrs. (100)
1791-1810	69	Less than 2 M.B.F.	White Pine (WP)	102-121 yrs. (120)
1831-1850	72	Old Cuttings	Subalpine (SA)	62-81 yrs. (80)
	87	Brush	Brush (Bh)	Selection Forest all ages (Z)
	300	Barren	Barren (Bn)	

OLD CUTTINGS.

Less than 1-3 of merchantable timber removed	Higgins' red Vertical hatching
1-3 to 2-3 merchantable removed	Higgins' red 45° NE-SW
More than 2-3 merchantable timber removed	Higgins' red 45° NW-SE

(Cutover symbols are to be used only in case timber left in cutting still constitutes the predominant age class, not being applicable to areas where the reproduction is more important than the mature timber).

Cultivable Land	Higgins' red Horizontal hatching
Doubtful cases may be indicated by	Higgins' red Horizontal broken hatching
Burns	Higgins' black Vertical hatching

(This symbol applicable only where merchantable dead timber is the material present of predominant importance. Where reproduction of a merchantable remnant of the mature stand is of predominant importance the area should be classed as the corresponding age class of the proper timber type).

Boundaries of Types and Age Classes, dotted lined.....

Boundaries of areas of merchantable timber, dash and dotted lines, as

M
--.—.—.—.—.—.—.—
NM

Reservoir Sites, Cultural Features, etc.—See "Signs, Symbols and Colors, 1912," issued in small booklet form.

Example: For a stand of timber in the white pine type 70 years old with .5 crown density the map would show this as follows: .5-WP—80. (The density is placed before type to avoid possible confusion in figures.)

Normality Description—Normality is the present condition of a stand discounted into terms of its expected yield at the end of the rotation. The term is most useful in such pure stands as lodgepole pine. Here it is considered that 1,000 seedlings per acre, well distributed, will result in the maximum production per acre. Less than this number results in reduced yield. More than this number has the same effect, through overcrowding and consequent reduction in growth.

The standard normality is 1.0. By a stand of .5 normality is meant one which is so understocked that it will by the end of the rotation, yield but half of what it could if properly stocked. By $\pm$.5 is indicated a stand which will yield the same amount but with this reduced yield the result of overcrowding. The following figures are indicative:

.3	300	per	acre	+.9	1500 per acre
.5	500	"	"	+.7	2000 " "
.7	700	"	"	+.5	3000 " "
.9	900	"	"	+.3	4000 " "
1.0	1000	"	"		

These figures refer to good distribution. Uneven distribution will lower the figures on understocked and raise them on overstocked areas. Uneven height growth will raise the figures on overstocked areas. All these figures are for the youngest age class and allowance must be made for older stands.

Determination of Streamflow in Cubic Feet per Second—The flow of a stream in cubic feet per second is easily obtained with sufficient accuracy for the purpose for which it is to be used as follows.

(a) Estimate the average width and the average depth of the stream in feet.

(b) Multiply the average width by the average depth to obtain the cross section area in square feet.

(c) Estimate the velocity in feet per second at a point where the cross section area is approximately the average for some distance.

(d) A product of (b) and (c) is the flow in cubic feet per second.

Filing System—The first essential is a moisture and rodent proof box. The Forest Service metal filing case with its three card-board transfer cases serves admirably. The filing may be done in letter mail envelopes, five series of these to be kept as follows:

1. Incomplete work, arranged alphabetically by names of estimators and compassmen.

2. Completed work.

a. Maps arranged by township and section usually one envelope for each township is sufficient.

b. Estimate and description sheets arranged by logging units. One envelope for each unit.

c. Summaries filed in separate envelopes by logging units

3. Blank forms, etc.

Assignment of forties to the several estimators may be recorded on blank township plats by entering in each forty a key letter identifying the estimator to which it is assigned. When completed the estimate sheet is turned in, the total estimate shown should then be entered under the key letter. Key letters without estimates thus indicate incompleted work.

The above system applies to surveyed areas, but may be easily modified to apply to unsurveyed projects.

Equipment—The following lists of equipment and provisions have been planned for the average ten-man crew.

LIST OF EQUIPMENT.

Instruments—

1 Transit, Gurley, Mountain, (Not always needed).
1 Level, Locks. " " "
8 Barometers, Aneroid.
8 Levels, Abney.
6 Compasses, F. S. Standard.
6 Compasses, box pocket.
6 Registers, tally.
6 Cruisers sticks.
5 Tapes, diameter.
1 to 4 Tapes, steel, (preferably 2½ chains).
1 Slide Rule.
1 Sketching case.
1 Adding Machine.
"T" Square, 24.
2 12' Scales, engineers'.
1 set drawing instruments.
1 Triangle, 45°.
1 Triangle, 30° and 60°.
1 Protractor.
Drawing ink—black, blue, red, orange.
Ink, fountain pen.
Pens, quill.
Pens, Gillott's No. 303.
Thumb Tacks, solid head, 6 doz.
Rubber bands.
Clips.
Blotters, small.
Wire No. 12, small amount, for setting up camp.
Nails.

Boards for Drafting—

24"x24" } 1"x12"x16' Matched
36"x36" }

Forms and Stationery, etc.—

Map books, Form No. 493.
Estimate books, Form 494.
Time slips.
Time books.
Summary Sheets.
1 case, ranger filing.
1 tatum folder.
1 file, collapsible.
Office note.
Yellow paper.
Envelopes.

Envelopes, Manila, 6"x8½" for estimate sheets.
Envelopes, Manila, 9½"x12".
Ranger notebooks No. 289.
Pencils 4H.
Pencils No. 2.
Drawing paper. Cloth back.
Tracing cloth.
Tracing paper, thinnest grade.

Tentage—

1 10"x12" (high wall) cook tent.
1 7"x9" commissary tent.
1 fly (large) mess tent.
1 10"x12" (high wall) drafting tent.
3 to 5, 7"x9" (wall tents) sleeping quarters

Miscellaneous Equipment—

1 Map case, 10"x40"x6".
3 table tops (canvas on bed of 2½ inch slats closely laid).
2 Baldwin lamps, (acetylene).

Provision List—Taken from Trail Manual 1913.
10 men for 10 days (100 rations).

Flour	100	lbs.
*Cured Meats	75	"
Potatoes	100	"
Beans	20	"
**Sugar	40	"
***Lard	10	" in 5 lb. pails.
Butter	10	" Creamery. 1 lb. cartons.
Dried Fruits	20	"
Coffee	10	" Good grade, ground 1 lb.
Rice	5	" sealed tins.
Tea	1	"
Cocoa	2	" ½ lb. cans.
Cheese	5	"
Macaroni	2	"
Milk	48	cans, Carnation grade.
Corn Beef	5	" 2 lbs.
Tomatoes	8	" 2½ lbs. solid pack.
Peas	5	" 2 lbs. solid pack.
Corn	10	" 1 lb. solid pack.
Sauer Kraut	4	" 3 lbs.
Rolled Oats	10	lbs.
Onions	10	"

*If fresh meat is available use 50 lbs., cured, 25 lbs. fresh.
**If syrup is preferred, reduce sugar accordingly.
***If fresh meat is used, increase lard to 15 lbs.

Corn Meal	5	lbs.
Graham Flour	5	"
Pan Cake Flour	5	"
Salt	3	"
Baking Powder	3	"
Soda	1	"
Yeast Cake	1	Package.
Eggs	10	Doz.
Catsup	2	Bot.
Pickles, sour	1	kit 2 gal.
Mustard, ground	4	oz. can.
Pepper, ground	8	" "
Cinnamon, ground	4	" "
Allspice, ground	4	" "
Lemon Ext	4	oz. Bot.
Vanilla Ext.	4	" "
Vinegar	1	qt. Bot.
Soap, laundry	5	lbs.
Matches	3	five cent packages.
Candles	2	lbs.
****Coal Oil	4	1 qt. bottles.

Dehydrated fruits and vegetables may be substituted for fresh fruits and vegetables in the ration of one pound of dried to seven pounds of fresh. The following dehydrated products are sometimes of great value in side or main camps:

Potatoes (riced).
Cabbage.
Spinach.
Carrots.
Onions.
Turnips.
Sweet corn.
Green peas.
String beans.
Cranberries.
Rhubarb.
Blueberries
Raspberries.
Strawberries.
Celery (ground).
Leeks (ground).

It may be advisable to add certain articles to the above list to provide for the cold lunch feature of reconnaissance work.

Approximate total weight, 550 lbs.
" " cost, $65.00.

****Coal oil will be replaced by carbide if Baldwin lamps are used.

Kitchen Outfit—(Taken from Trail Manual 1913).

Crew of 10 men, including foreman and cook.

1 Lantern.
2 S. B. Axes.
1 Sheet steel cook stove No. 8, with 6 joints pipe.
4 Fry pans, assorted sizes.
2 Granite kettles, 12 qt., with covers
4 " " 6 " " "
2 " stew kettles, 6 qt., with covers.
1 Granite coffee pot, 8 qt.
1 Granite tea pot, 3 qt.
2 Dishpans, 14 qt.
1 Granite rice boiler, 6 in.
2 Dripping pans to fit oven of stove.
1 Can opener.
1 Rolling pin.
4 Tin wash basins.
4 Tin water pails, 10 qt.
3 Tin dippers, 1 qt.
1½ doz. Granite plates.
1½ doz. " cups and saucers.
½ doz. " dish up basins, 2 qt.
½ doz. " " " " 1 qt.
1 doz. Mush bowls.
1 Granite syrup pitcher, 1 qt.
1 " cream pitcher, 1 qt.
2 Butcher knives, 1-10 in., 1-12 in.
1 " steel.
1 Meat fork.
2 Granite stirring spoons.
1 Meat saw.
4 Tin milk pans, 6 qt.
1½ doz. Wood handled steel knives and forks.
1½ doz. Teaspoons.
1½ doz. Tablespoons.
5 1-Gal slop cans, galvanized iron.
*5 yds. 12 oz. ducking or light canvas, 36 in. wide.
½ lb. 10 oz. tacks.
10 lbs. Assorted nails.
1 Carpenter's hammer.
1 " hand saw.
1 Alarm clock.
10 yds. Crash towling.
10 yds. Unbleached muslin.

Approximate total weight 325 lbs.

Approximate total cost $62.00.

*This item is intended to be used for tops for table frames built of light poles and is already covered under miscellaneous equipment.

The tin pails may be replaced by canvas pails, and one pitcher each for milk and syrup added.

SUMMARY SHEET FORMS.

The sample summaries here given are adopted in the effort to secure direct utilization of all data collected in the field.

In case of the sample summary of silvical data the first table only is prepared with mathematical accuracy, the acreage figures under type and age class being accurately obtained from the map. The other figures of this summary and of the logging data summary are comparatively rough approximations, the field sheets and maps being used to check and supplement the personal knowledge of the chief.

Summaries of estimate data by logging units and probable timber sale chances will be made as indicated in the sample summary sheet form.

It is evident that it will be necessary to determine the average stand per acre by species for certain type and age classes, within the logging chance for use in connection with appraisal and marking. The estimates should therefore be further summarized in the following manner:

When such demands can be anticipated the estimates should be further summarized in the following manner:

A certain number of estimate sheets within each age class of each type will be selected, and the estimates for the average sample acre obtained in each case. The special age classes and types here distinguished must be determined with reference to the marking plans for the logging chance under consideration.

These results may be tabulated as below (j—r) together with acreage figures (a—i). Figures representing total calculated volume (aj—ir) are then directly obtained and the ratio between this total for the whole chance and the actual total estimate for the whole chance $\frac{S}{S'}$ easily secured. This ratio applied as a correction factor to the separate calculated total volumes for each species of each age class of each type will give the stand by species for age class and type of the logging chance with sufficient accuracy to meet the needs of the marking plans. Figures for the average acres may be then obtained by division. In the tabulation given below it is to be noted that several species will normally appear under each age class of each type.

LOGGING CHANCE.

Type	Age Classes (By species)	Acres summary from silvical data	Volume per A. From representative estimate sheets	Total cal. vol.	Actual Est. From est. summary of unit	Calculated estimates corrected	Stand per A.
A	1	a	j	aj		$\frac{aj.S}{S'}$	$\frac{js}{S'}$
	2	b	k	bk		$\frac{bk.S}{S'}$	$\frac{ks}{S'}$
	3	c	l	cl		$\frac{cl.S}{S'}$	$\frac{ls}{S}$
B	1	d	m	dm		$\frac{dm.S}{S'}$	$\frac{ms}{S'}$
	2	e	n	en		$\frac{en.S}{S'}$	$\frac{ns}{S'}$
	3	f	o	fo		$\frac{fo.S}{S'}$	$\frac{os}{S'}$
C	1	g	p	gp		$\frac{gp.S}{S'}$	$\frac{ps}{S'}$
	2	h	q	hq		$\frac{hq.S}{S'}$	$\frac{qs}{S'}$
	3	i	r	ir		$\frac{ir.S}{S'}$	$\frac{rs}{S'}$
Total for chance				S'	S		

SAMPLE SUMMARY OF ESTIMATES

(To be used for each logging unit and also for the probable timber sale chance as a whole.)

Logging Unit **Smith Creek**

Species	Total stand M. bd. ft.	Cull %	Stand per A. M. b. ft.	%	No. Logs	Logs per M.	No. Trees	Logs per Tree	Poles 25	Poles 30	Poles 35
White Pine											
10"-28"	12,000	10	4.0	16	48,000	4	6,000	8			
30" and over	8,000		6.0	24	80,000	10	16,000	5			
Cedar	5,000	15	2.5	10	40,000	8	10,000	4	10,000	5,000	5,000
West. Fir											
Sound	10,000	10	5.0	20	100,000	10	20,000	5			
Defective	15,000	40	7.5	30	150,000		30,000				
Totals - -	50,000		25.0	100	418,000	8.4	82,000	5	10,000	5,000	5,000

SAMPLE SUMMARY.

Logging Data, Smith Creek.

Cutting and Skidding Factors—Surface: 80% smooth; 20% rough, (concentrated in section 18, north of creek).

Soil: 100% firm.

Rock: Continuous ledges about 20 feet high are found on north side of creek in sections 18 and 19. Small areas of slide rock in section 7, not affecting logging seriously.

Underbrush: W. P. 200+. Hemlock, white fir, and yew of moderate density, averaging 10 feet in height, covering 40% of area. W. P. 80-160, inc., hemlock and white fir, density, light, covering less than 10% of area. (Etc. for other types and age classes).

Windfall: Light, 10% of area (section 7) average diameter 6", moderate, 70% of area average diameter 10". Heavy, 20% of area average diameter 10".

Transportation Factors—Draws—Soil 100 % firm.

Rock: Lower 100 yards of draws coming into creek from north in sections 18 and 19 become narrow canyons cut 20 feet into the ledge rock; some slide rock in section 7. Not a factor elsewhere.

Underbrush—60% moderate. 40% light. Of little importance as transportation factor.

Windfall—Moderate and of 20" material. 50% of area; heavy and of 12" material. 50% of area.

Streams—Main Smith Creek has a flow of approximately 10 cubic feet per second. A regular gradient of about 2%. Its average width varies from 7 to 8 feet at the Forks to 20 feet at its confluence with Jones Creek. The banks are good for driving. (Important branch streams to be treated in similar manner).

Stream Bottoms—Soil: 70% firm. 30% soft. (in section 19, S½).

Rock. None that hinders road building.

Underbrush: Heavy, 50%; moderate, 50%.

Windfall: Heavy and of 15" material, 60%; moderate and of 10" material, 40%. Min. width of main stream bottom 70 feet. North branch 30 feet for 1½ miles, south branch 20 feet for 1 mile then 10 feet for ½ mile.

Miscellaneous—There is an excellent dam site in section 7, requiring about 100 feet of wing construction.

SAMPLE SUMMARY SILVICAL DATA FLAT CREEK.

Types and Age Classes.

Type	Av. Density	Age Class	Area	
W. P.	.7	20	100	
" "	.5	60	200	
" "	.3	160	400	
" "	.1	200+	1800	
" "		All		2500
D. F.	.3	120	400	
" "	.3	160	200	
" "		All		600
L. P.	.4	120	300	300
		Total.		3400

CONDITION OF STAND.

Thrifty: W. P. 20 & 60.
D. F. 120 (about 50%).
Mature: W. P. 160.
D. F. 120 (about 50%).
D. F. 160.
L. P. 120.
Decadent: W. P. 200+

Total acreage, thrifty, 500; mature, 1100; decadent, 1800.

DAMAGE.

Fire: About 200 acres in W. P. 200+ and 50 in D. F. 160, 80% of trees damaged.

Insects: Bark beetles reported generally throughout W. P. 160 and 200+. Special examination urgent.

Clear Length.

Type	Age	Species	Clear Length
W. P.	160	W. P.	2
		D. F.	1
		L.	3
	200+	W. P.	5
		D. F.	2
		L.	6
D. F.	120 & 160	D. F.	1
L. P.	120	L. P.	1

Soil

Type	Age	Soil.
W. P.	All	Sand-loam, fresh; moderate to deep.
D. F.	All	" dry, shallow to moderate.
L. P.	All	" " " " "

Rock.

Granite formation underlies almost whole area. About a section of limestone at extreme north end, in W. P. Type.

Undergrowth.

Type	Age	Density	Per Cent Area
W. P.	20	Open	5
	60	Open	5
	160	Open	5
	200+	Open	50
D. F.	120	Medium	15
	160	Close	25
L. P.	120	Open	5

Young Growth.

Type	Age	No. Per. A.	Species	Per Cent	Distribution
W. P.	20	2,000	W. P. 20;	L. 40; W. P. 40.	Singly
W. P.	60	600	W. P. 50;	L. 30; W. F. 20.	Singly

VARIATION IN METHODS.

The Chief of Party may find the following suggestions helpful when special conditions are encountered.

THE QUARTER ACRE CIRCULAR PLOT.

In stands of timber of small value scattered over large areas, a one-man crew may be used to good advantage for mapping and estimating. The estimating may be most effectively done in such a case by the taking of one quarter acre circular plots approximately 60 feet in radius at two and one-half chain intervals. The area covered by such a tally will be equivalent to a strip one chain in width.

GROUP TALLYING.

In timber which is characteristically uniform in size within one or two ranges of d. b. h. each range having differences limited to 6-10 inches and where few species are concerned the following method has been found of value in increasing the speed and conserving the judgment of the estimator. All the trees on the strip are counted, but only a certain proportion (as one in five) of them are individually sized up and tallied. The first 20 trees on a strip may be counted without tally and the next five trees nearest the estimator tallied five times each by species d. b. h. and log length. If there are two distinct sizes they may be treated separately, two counts being carried simultaneously by the estimator, or each tree of the larger size may be tallied and the smaller size tallied by groups.

Broken Tally—The tally on a strip is sometimes taken only at regular intervals arbitrarily determined. This rectangular plot method results in relief to the estimator and has some of the advantages of the circular plot method. It is considered preferable to making a reduction in the width of the strip below the minimum of one chain but is seldom, if ever, to be used by any but one-man crews.

Variation in Width of Strip—In open stands of valuable timber it is sometimes possible to secure the best results by the use of a broad strip, perhaps two chains in width. In certain cases this will double the per cent of the stands tallied with little or no reduction in the length of strip which can be run per day. The advisability of using a strip of width greater than one chain should be carefully considered before estimating open stands of yellow pine and larch.

The Use of Chain by Estimating Crew—When it is found impracticable to have control lines within reliable pacing distance of each other and when the Abney is used for elevation control, it will be found necessary to use the chain. A steel tape two or two and one-half chains in length is recommended.

MULTIPLE VOLUME TABLE—WESTERN WHITE PINE

Values from 40" to 60" D. B. H. assumed.
(Constructed by the Frustum Form Factor method. Based on 306 trees from the Coeur d'Alene, St. Joe and Lolo National Forests.)
Scribner Decimal C Rule.

Number of Trees.

DBH	Logs	1	2	3	4	5	6	7	8	9
8	1	2.5	5	8	10	12.5	15	17.5	20	20
	2	5	9.5	14.5	19	24	29	33.5	38.5	43
	3	7.5	15	22.5	30	37.5	45	52.5	60	67.5
10	1	2.5	5.5	8	11	13.5	16	19	21.5	24
	2	5	10.5	15.5	21	26	31	36.5	41.5	47
	3	9	17.5	26.5	35.5	44.5	53	62	71	79.5
	4	12.5	24.5	37	49	61.5	74	86	98.5	111
12	1	3	6	8.5	11.5	14.5	17.5	20	23	26
	2	6	12	18	24	30	36	42.5	48.5	54.5
	3	10.5	21	31	41.5	52	62.5	73	83	93.5
	4	15	30	45	60.5	75.5	90.5	106	121	136
	5	19.5	39	59	78.5	98	118	137.5	157	177
	6	24	48.5	72.5	96.5	121	145	169.5	193.5	218
14	1	3	6	9	12.5	15.5	18.5	21.5	25	28
	2	7	14	21	28	35	42.5	49.5	56.5	63.5
	3	13	26.5	39.5	53	66	79	92.5	105.5	119
	4	18.5	37	56	74.5	93	111.5	130	149	167.5
	5	25	49.5	74.5	99	124	149	173.5	198.5	223
	6	31	61.5	92.5	123	154	185	216	246.5	277
	7	36.5	73	109.5	146	182.5	219	255.5	292	328
	8	42.5	85	127.5	170	225	255	298	340	383
16	1	3.5	7	11	14	17.5	21	24.5	28	31.5
	2	8.5	17	26	34.5	43	51.5	60	69	77.5
	3	16	32	47.5	63.5	79.5	95.5	111	127	143
	4	23.5	46.5	70	93	116.5	140	163	186	210
	5	30.5	61	91.5	122	152.5	183	213.5	244	275
	6	38.5	77	116	154.5	193	231.5	270	309	347
	7	46	92.5	139	185	231.5	278	324	370	417
	8	54	108	162	216	270	324	378	432	486
18	1	4	8	11.5	15.5	19.5	23.5	27.5	31	35
	2	10	20	30	40	50	60	70	80	90
	3	19	37.5	56	75	94	112.5	131	150	168.5
	4	29	57.5	86.5	115	144	173	202	230	259
	5	38	75.5	113.5	151	189	227	265	302	340
	6	46.5	93	139.5	186	232.5	279	325	372	420
	7	57	113.5	170.5	227	284	341	397	454	510
	8	66	132.5	199	265	331	398	464	530	596
20	1	4.5	8.5	13	17	21.5	26	30	34.5	39
	2	12	24	35.5	47.5	59	71	83	95	106.5
	3	23.5	46.5	70	93	118	141.5	165	189	212
	4	34	68.5	102.5	137	171	205	239	273.5	308.5
	5	46	91.5	137.5	183	229	275	321	367	412
	6	58	115.5	173	231	288	346	404	462	520
	7	68.5	137	205.5	274	343	412	480	548	616
	8	81	162	243	324	405	486	567	648	730

MULTIPLE VOLUME TABLE—WESTERN WHITE PINE

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
22	1	5	9	14	19	24	28	33	38	43
	2	13	27	41	54	68	81	95	109	122
	3	27	54	82	109	136	163	191	218	245
	4	41	81	122	163	203	244	285	326	366
	5	55	110	165	220	275	330	385	440	495
	6	69	138	207	276	345	414	473	552	620
	7	84	168	252	336	420	504	587	670	755
	8	97	195	292	390	487	584	682	780	876
	9	112	224	336	448	560	672	784	896	1008
24	1	5	10	15	21	26	31	36	42	47
	2	16	33	49	66	82	99	115	132	148
	3	32	64	96	127	159	191	223	255	287
	4	48	97	145	193	242	291	339	388	436
	5	65	131	196	262	327	392	475	524	588
	6	82	164	246	328	410	492	574	657	738
	7	97	195	293	391	488	586	684	782	879
	8	116	232	348	464	580	696	812	928	1045
	9	132	264	396	527	659	791	923	1052	1185
26	1	5	11	17	22	28	33	39	45	50
	2	18	36	54	72	90	108	127	145	163
	3	37	74	111	148	185	222	259	296	333
	4	55	111	167	223	278	334	390	445	500
	5	77	155	232	310	387	465	542	620	695
	6	94	189	283	378	472	566	662	755	850
	7	115	230	345	460	575	690	805	920	1035
	8	133	266	399	532	665	798	931	1065	1200
	9	153	306	459	612	765	918	1070	1225	1375
28	2	20	41	62	83	103	124	145	165	186
	3	42	85	127	170	212	255	298	350	383
	4	64	129	193	258	322	387	451	516	580
	5	87	174	261	348	435	522	609	696	783
	6	109	218	328	438	547	656	765	875	985
	7	132	264	396	528	660	792	924	1055	1189
	8	156	312	468	624	780	936	1092	1248	1404
	9	179	358	537	716	895	1074	1253	1432	1611
30	2	23	46	69	93	116	139	162	186	209
	3	47	94	141	188	235	282	329	376	423
	4	72	144	216	288	360	432	504	576	648
	5	100	200	300	400	500	600	700	800	900
	6	124	248	372	496	620	744	868	992	1116
	7	152	304	456	608	760	913	1064	1216	1368
	8	176	351	530	706	883	1060	1235	1410	1590
	9	201	402	603	804	1005	1206	1407	1610	1810
32	3	55	111	166	222	277	333	388	444	499
	4	83	167	250	333	416	500	583	666	750
	5	113	226	338	452	564	676	790	902	1015
	6	142	284	425	567	710	851	993	1135	1275
	7	170	340	510	680	850	1020	1190	1360	1530
	8	198	397	595	794	993	1190	1390	1588	1785
	9	229	458	687	916	1145	1375	1605	1835	2060
	10	258	515	773	1030	1288	1545	1800	2060	2320

MULTIPLE VOLUME TABLE—WESTERN WHITE PINE

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
34	3	60	121	182	243	303	364	725	485	546
	4	94	188	283	377	472	566	660	755	850
	5	124	248	373	496	621	745	870	994	1118
	6	157	315	472	630	786	945	1100	1258	1415
	7	188	378	566	755	944	1132	1320	1510	1700
	8	223	446	670	893	1115	1340	1560	1785	2010
	9	255	510	765	1020	1275	1530	1785	2040	2300
	10	288	577	866	1152	1440	1730	2020	2305	2600
36	3	67	134	201	268	335	402	468	536	603
	4	101	202	303	404	505	606	707	808	909
	5	136	272	408	544	680	816	952	1089	1225
	6	174	348	522	695	870	1042	1215	1390	1562
	7	210	420	630	840	1050	1260	1470	1680	1890
	8	241	482	724	965	1205	1445	1685	1930	2170
	9	279	558	836	1115	1395	1675	1950	2230	2510
	10	316	632	950	1265	1580	1895	2210	2530	2840
38	3	74	147	241	295	369	443	516	590	664
	4	110	220	330	440	550	660	770	880	990
	5	150	300	450	609	750	900	1050	1200	1350
	6	189	378	567	756	945	1135	1325	1512	1700
	7	226	452	678	905	1130	1355	1580	1810	2035
	8	261	522	784	1045	1305	1565	1825	2090	2350
	9	306	613	920	1225	1530	1840	2140	2450	2760
	10	346	692	1038	1385	1730	2075	2420	2770	3110
40	4	122	244	366	488	610	732	854	976	1100
	5	165	330	495	660	825	990	1155	1320	1485
	6	204	410	614	818	1022	1228	1442	1636	1840
	7	251	505	755	1005	1255	1505	1755	2010	2260
	8	294	588	885	1175	1470	1760	2060	2645	2940
	9	336	672	1015	1345	1680	2015	2350	2690	3015
	10	382	764	1145	1530	1910	2290	2685	3060	3440
42	4	132	264	396	528	660	792	924	1056	1188
	5	179	359	539	718	897	1078	1258	1435	1615
	6	225	450	675	900	1125	1350	1575	1800	2025
	7	276	552	828	1105	1380	1655	1930	2205	2480
	8	320	640	960	1280	1600	1920	2240	2560	2880
	9	365	730	1090	1460	1825	2190	2555	2920	3280
	10	417	834	1250	1665	2080	2500	2915	3330	3750
44	5	194	388	582	776	970	1165	1360	1550	1745
	6	245	490	735	980	1225	1470	1715	1960	2205
	7	298	596	894	1195	1490	1785	2085	2380	2680
	8	346	692	1040	1385	1730	2075	2425	2770	3115
	9	396	792	1188	1585	1980	2375	2770	3170	3560
	10	452	904	1355	1805	2280	2710	3160	3610	4060
46	5	209	419	628	838	1048	1258	1465	1675	1885
	6	264	528	792	1055	1320	1585	1850	2110	2375
	7	323	646	970	1290	1615	1935	2260	2580	2905
	8	370	740	1110	1480	1850	2220	2590	2960	3330
	9	427	855	1285	1710	2135	2560	2990	3420	3850
	10	490	980	1470	1960	2450	2940	3430	3920	4410
48	6	282	564	846	1128	1410	1690	1975	2255	2540
	7	348	696	1045	1390	1740	2090	2435	2785	3130
	8	400	800	1200	1600	2000	2400	2800	3200	3600
	9	456	912	1370	1825	2280	2735	3190	3650	4100

MULTIPLE VOLUME TABLE—WESTERN WHITE PINE

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
	10	526	1050	1580	2100	2630	3160	3680	4210	4740
50	6	320	640	960	1280	1600	1920	2240	2560	2880
	7	372	744	1115	1490	1860	2230	2600	2975	3350
	8	427	855	1280	1710	2140	2565	2990	3420	3850
	9	495	990	1485	1980	2470	2970	3460	3960	4450
	10	562	1125	1685	2250	3810	3380	3940	4500	5060
52	6	326	652	978	1305	1630	1955	2280	2610	2925
	7	396	792	1190	1585	1980	2380	2775	3175	3560
	8	460	920	1380	1840	2300	2760	3220	3680	4140
	9	529	1060	1590	2120	2650	3180	3710	4240	4770
	10	606	1210	1820	2425	3030	3635	4240	4850	5450
54	6	350	700	1150	1400	1750	2100	2450	2800	3150
	7	423	846	1270	1695	2120	2540	2960	3390	3810
	8	497	994	1490	1985	2480	2980	3480	3970	4470
	9	570	1140	1710	2280	2850	3420	3990	4560	5130
	10	649	1298	1945	2600	3240	3890	4540	5190	5840
56	6	373	746	1120	1490	1865	2240	2610	2985	3360
	7	450	900	1350	1800	2250	2700	3150	3600	4050
	8	527	1055	1580	2110	2640	3160	3690	4225	4750
	9	605	1210	1815	2420	3025	3630	4240	4840	5450
	10	690	1380	2070	3760	3450	4140	4825	5525	6200
58	8	560	1120	1680	2240	2800	3360	3920	4480	5040
	9	639	1278	1915	2550	3190	3830	4470	5100	5750
	10	729	1460	2180	2910	3640	4370	5100	5830	6560
60	8	592	1180	1770	2360	2960	3550	4140	4730	5325
	9	672	1345	2010	2690	3360	4030	4700	5375	6050
	10	770	1540	2310	3080	3850	4625	5400	6160	6940

WESTERN YELLOW PINE

Bitterroot, Blackfeet, Kootenai, and Missoula National Forests, Montana.
Curved. Scribner Decimal C.

Diameter Breast High	Number of 16-Foot Logs								Basis
Inches	1¼	2	3	4	5	6	7	8	Trees
				Volume—Board Feet.					
8	2.0	3.5	5.5						7
9	2.5	4	6						17
10	3	4.5	7	10					30
11	3.5	5	8	12					88
12	4	5.5	9	13	18				163
13	4	6	10	14	20				201
14	4.5	7.0	12	16	23				202
15	5	8	13	19	26				254
16	6	9	15	22	29	38			221
17		10	17	25	33	42			230
18		11	19	28	37	47			211
19		12	21	31	41	53			184
20		14	23	35	46	59	72		175
21		15	26	38	52	65	79		151
22		17	29	43	57	72	87		128
23		19	32	47	64	79	95		94
24			35	52	70	86	104	124	88
25			39	58	76	94	114	136	79
26			43	64	84	103	125	148	76
27			48	70	92	113	137	161	51
28			53	78	101	124	149	174	40
29			59	85	110	136	162	188	26
30			65	93	121	148	175	203	38
31			72	102	132	160	188	218	15
32			80	112	143	172	201	234	15
33				122	154	185	216	250	13
34				133	165	198	230	266	5
35				145	177	211	245	282	8
36				157	189	224	260	298	3
37				170	201	238	275	314	1
38				183	214	252	290	330	4
39				196	227	266	306	346	1
40				210	241	280	322	362	3
									2822

Top diameter inside bark 6 inches throughout.

Stump height one foot.

Scaled from taper curves, mostly in 16.3 foot logs, with a few shorter logs where necessary.

MULTIPLE VOLUME TABLE—LARCH

(Constructed by the Frustum Form Factor method. Based on 233 trees.)
Scribner Decimal C Rule.

Number of Trees.

DBH	Logs	1	2	3	4	5	6	7	8	9
8	1	2.5	4.5	7	9.5	11.5	14	16.5	19	21
	2	4.5	8.5	13	17	21.5	26	30	34.5	39
	3	7	13.5	20	27	34	40.5	47	54	61
	4	9.5	18.5	28	37	46.5	56	65	74.5	84
10	1	2.5	5	7.5	10	12	14.5	17	19.5	22
	2	4.5	9.5	14	19	23.5	28	33	37.5	42.5
	3	8	16	24	32	40	48	56	64	72
	4	11	22	33	44.5	55.5	66.5	77.5	89	100
12	1	2.5	5	8	10.5	13	15.5	18	21	23.5
	2	5.5	11	16.5	22	27	32.5	38	43.5	49
	3	9.5	19	28	37.5	47	56.5	66	75	84.5
	4	13.5	26	41	54.5	68	81.5	95	109	122.5
	5	18	36	53.5	71.5	89	107	125	143	161
	6	22	44	65.5	87.5	109.5	131.5	153.5	175.5	197.5
14	1	3	5.5	8.5	11	14	16.5	19.5	22.5	25
	2	6.5	13	19	25.5	32	38.5	45	51	57.5
	3	12	23.5	35.5	47.5	59	71	83	95	107
	4	17	33.5	50.5	67	84	101	118	134.5	151
	5	22.5	45	57	89.5	112	134.5	157	179	202
	6	28	55.5	83.5	111	139	166.5	195	222	250
	7	33	66	99	132	165	198	231	264	297
	8	38.5	77	115	153.5	192	230	269	307	346
16	1	3	6.5	9.5	13	16	19	22.5	25.5	29
	2	8	15.5	23.5	31	39	47	54.5	62.5	70
	3	14.5	29	43	57.5	72	86.5	101	115	129.5
	4	21	42	63	84	105	126	147	168	189
	5	27.5	55	82.5	110	137.5	165	192	220	247
	6	35	69.5	104.5	139	174	209	244	278	313
	7	42	84	125.5	167.5	209	251	293	335	376
	8	49	97.5	146	195	243	292	341	390	438
18	1	3.5	7	10.5	14	17.5	21	24.5	28	31.5
	2	9	18	27	36	45	54	63	72	81
	3	17	34	51	68	85	101	118	135	152
	4	26	52	78	104	130	156	182	208	234
	5	34	68	102	136	170	204	238	272	306
	6	42	84	126	168	210	252	294	336	378
	7	51	102	153	204	256	307	358	410	460
	8	60	120	180	240	300	360	420	480	540
	9	68.5	136.5	205	273	342	410	478	546	615
	10	77	153.5	230	307	384	460	538	615	690
20	1	3.5	7.5	11	15	19	22.5	26	30	34
	2	10	20.5	31	41	51	61.5	72	82	92
	3	20	40.5	60.5	81	101	121	141.5	161.5	182
	4	29.5	59	89	118	148	177.5	207	236	266
	5	39.5	79	119	158	198	238	277	317	356
	6	50	100	150	200	250	300	350	400	450
	7	59	118	177.5	236	296	355	414	473	532
	8	70	140	210	280	350	420	490	560	630

MULTIPLE VOLUME TABLE—LARCH

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
	9	80	160	240	320	400	480	560	640	720
	10	90	180	270	360	450	540	630	720	810
22	1	4	8	12	16	20	23	27	31	35
	2	11	22	34	45	57	68	79	91	102
	3	23	45	68	91	114	137	160	182	205
	4	34	68	102	136	170	204	238	272	306
	5	46	92	137	184	229	275	321	367	413
	6	57	115	173	230	288	346	404	462	518
	7	70	140	210	280	350	420	490	560	630
	8	81	162	243	324	405	486	568	650	730
	9	93	187	281	374	468	562	655	750	842
	10	105	210	315	420	524	630	735	840	944
24	2	14	27	41	55	69	82	96	110	124
	3	26	53	80	106	133	159	186	213	239
	4	40	81	121	162	202	243	283	323	364
	5	54	109	163	218	273	327	382	436	490
	6	68	137	205	274	342	410	480	548	616
	7	81	163	245	326	408	490	570	683	735
	8	96	193	290	386	483	580	676	773	870
	9	110	220	330	440	550	660	770	880	990
	10	124	249	374	498	623	748	772	996	1120
26	2	15	30	45	60	75	90	105	120	135
	3	34	78	102	136	170	204	238	272	306
	4	46	93	139	185	232	278	324	371	418
	5	62	124	186	248	310	372	434	495	558
	6	79	158	237	316	395	474	553	630	710
	7	95	191	287	382	478	574	670	765	860
	8	111	222	333	444	555	666	777	888	999
	9	127	254	381	508	635	762	890	1015	1140
	10	143	286	430	573	715	860	1000	1145	1290
28	2	17	34	51	68	85	102	119	136	153
	3	35	70	105	140	175	210	245	280	315
	4	53	106	159	212	265	318	371	424	477
	5	71	143	214	286	357	430	500	572	644
	6	90	180	270	360	450	540	630	720	810
	7	109	218	327	436	545	654	763	872	981
	8	128	257	385	513	642	770	900	1030	1155
	9	147	294	440	590	735	883	1040	1175	1325
	10	165	330	495	660	825	990	1155	1320	1485
30	3	39	78	117	157	196	235	274	314	353
	4	60	120	180	240	300	360	420	480	540
	5	83	166	249	332	415	500	580	664	746
	6	103	206	310	413	516	620	723	825	930
	7	126	252	378	504	630	755	880	1010	1135
	8	147	294	440	587	735	880	1030	1175	1320
	9	168	346	504	682	840	1010	1175	1345	1510
	10	189	378	567	756	945	1135	1320	1510	1700
32	3	44	88	132	176	220	264	308	352	396
	4	67	135	203	270	338	405	473	540	608
	5	91	183	274	366	457	550	640	733	824
	6	115	230	345	460	575	690	805	920	1035
	7	138	276	414	550	690	830	965	1105	1240
	8	161	322	484	645	805	967	1130	1290	1450
	9	186	372	558	744	930	1115	1300	1490	1675

MULTIPLE VOLUME TABLE—LARCH

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
	10	209	418	627	835	1045	1250	1460	1670	1880
34	4	74	149	223	298	372	446	520	596	670
	5	98	196	294	392	490	590	686	785	883
	6	124	248	372	496	620	745	870	990	1115
	7	149	298	446	595	745	895	1045	1190	1340
	8	176	352	528	705	880	1060	1230	1410	1585
	9	202	404	605	806	1010	1210	1410	1610	1815
	10	227	454	682	910	1135	1360	1590	1820	2040
36	5	107	214	321	428	535	642	749	856	963
	6	137	274	410	548	675	823	960	1100	1370
	7	165	330	495	660	825	990	1150	1320	1480
	8	191	382	574	765	955	1150	1340	1530	1720
	9	220	440	660	880	1100	1320	1540	1760	1980
	10	248	497	745	994	1240	1490	1740	1985	2480
38	5	117	234	350	467	584	700	818	935	1050
	6	146	293	440	585	733	880	1025	1170	1320
	7	175	350	525	700	875	1050	1225	1400	1575
	8	203	406	610	810	1015	1220	1420	1625	1830
	9	238	476	714	955	1190	1430	1665	1900	2140
	10	267	535	800	1065	1330	1600	1870	2140	2400
40	5	126	252	378	504	630	756	882	1010	1135
	6	157	314	470	628	785	940	1100	1250	1410
	7	192	384	575	770	960	1150	1345	1540	1730
	8	225	450	675	900	1125	1350	1575	1800	2020
	9	257	514	770	1030	1285	1540	1800	2060	2310
	10	292	584	875	1170	1460	1750	2040	2340	2630

MULTIPLE VOLUME TABLE—DOUGLAS FIR

(Constructed by the Frustum Form Factor method.) Scribner Decimal C Rule.

Number of Trees.

DBH	Logs	1	2	3	4	5	6	7	8	9
8	1	2.5	5	7	9.5	12	14.5	17	19	21.5
	2	4.5	8.5	13	17.5	22	26	30.5	35	39
	3	7.0	13.5	20.5	27.5	34	41	48	55	61.5
10	1	2.5	5	7.5	10	12	14.5	17	19.5	22
	2	4.5	9.5	14	19	24	28.5	33	38	43
	3	8.0	16	24	32	40	48	56.5	64.5	72.5
	4	11.0	22.5	33.5	45	56	67	78.5	89.5	101
12	1	2.5	5.5	8	10.5	13	16	18.5	21	24
	2	5.5	11	16.5	22	27.5	33	38.5	44	49.5
	3	9.5	19	28.5	38	47.5	57	66.5	76	85.5
	4	14.0	27.5	41.5	45	69	83	96.5	110.5	124
	5	18.0	36	54	72	90.5	108	126	144	162
	6	22.0	44	66.5	88.5	111	133	155	177	199
14	1	3.0	5.5	8.5	11	14	17	19.5	22.5	25
	2	6.5	13	19	25.5	32	38.5	45	51	57.5
	3	12.0	23.5	35.5	47.5	59.5	71	83	95	107
	4	17.0	33.5	50.5	67	84	101	117.5	134.5	151
	5	22.5	45	67.5	89.5	112	134.5	157	179	202
	6	28.0	55.5	83.5	111	139	166.5	194.5	222	250
16	1	3.0	6	9.5	12.5	16	19	22.5	25.5	29
	2	8.0	15.5	23.5	31	39	47	54.5	62.5	70
	3	14.5	29	43	57.5	72	86.5	101	115	144
	4	21.0	42	63	84	105	126	147	168	189
	5	27.5	55	82.5	110	137.5	165	192.5	220	248
	6	35.0	70	105	139.5	174.5	210	244	280	314
	7	42.0	84	125.5	167.5	209	251	293	335	378
	8	48.5	97.5	146	194.5	243	292	340	389	438
18	1	3.5	7	10.5	14	17.5	21	24.5	28	31.5
	2	9.0	18	36	45	54	63	72	81	99
	3	17.0	34	51	67.5	84.5	101.5	118	135	152
	4	26.0	52	65	78	104	130	156	182	208
	5	34.0	68	102	136	170.5	204.5	239	273	307
	6	42	84	126	168	210	252	294	336	378
	7	51	102	153	204	257	307	358	408	460
	8	60	120	179.5	239	299	359	418	478	538
20	1	4	7.5	11.5	15.5	19	23	27	31	35
	2	10.5	21	32	42.5	53	63.5	74	85	95.5
	3	21	40.5	62.5	83	104	125	146	166.5	187.5
	4	30.5	61	92	122.5	153	183.5	214	245	276
	5	41	82	123	164	205	246	287	328	369
	6	51.5	103	155	206	258	310	361	413	464
20	7	61	122	183.5	244	306	367	428	488	550
	8	72.5	145	217	290	362	435	506	580	651
22	1	4	8	12	16	21	25	29	33	37
	2	12	23	35	47	59	71	82	94	106
	3	24	48	71	95	119	143	167	191	214
	4	35	71	107	142	178	214	249	285	321
	5	48	96	144	192	240	288	336	384	432
	6	60	121	181	242	302	362	423	484	543
	7	73	146	219	292	356	439	512	585	659
	8	85	170	255	340	425	510	595	680	765

MULTIPLE VOLUME TABLE—DOUGLAS FIR

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
24	1	4	9	13	18	22	27	31	36	40
	2	14	28	42	56	70	84	99	113	127
	3	27	54	82	109	136	164	191	218	247
	4	41	83	124	165	207	248	290	331	373
	5	56	111	167	223	279	335	391	446	502
	6	70	140	210	280	350	420	490	560	630
	7	83	167	250	334	418	501	585	668	752
	8	98	195	293	391	490	586	685	782	880
26	1	5	9	14	19	24	29	33	38	43
	2	15	31	46	61	77	92	108	123	139
	3	31	63	94	126	157	189	220	252	284
	4	47	95	142	190	238	285	333	380	428
	5	63	126	190	253	317	380	444	506	570
	6	80	161	242	322	403	484	565	645	725
	7	98	196	294	392	490	589	686	785	883
	8	113	227	340	454	568	680	795	908	1025
28	2	17	35	53	70	88	106	123	141	159
	3	36	72	108	145	181	217	253	290	326
	4	55	110	165	220	275	330	385	440	495
	5	74	148	222	296	370	444	518	592	665
	6	93	187	280	374	468	560	655	748	840
	7	113	226	339	452	565	678	790	904	1020
	8	133	268	399	532	665	800	930	1065	1197
30	2	20	40	60	80	100	120	140	160	180
	3	40	81	121	162	202	243	284	324	364
	4	62	124	186	248	310	372	434	496	558
	5	86	172	258	344	430	516	602	688	774
	6	107	214	321	428	535	642	750	856	963
	7	131	262	393	524	655	786	918	1050	1180
	8	152	304	456	608	760	912	1065	1215	1360
32	3	46	93	140	186	233	280	326	373	420
	4	72	143	215	287	359	430	503	574	646
	5	97	194	291	388	485	582	680	775	875
	6	122	244	366	488	610	732	853	975	1100
	7	146	293	440	586	733	880	1025	1170	1320
	8	171	342	513	684	855	1025	1200	1370	1540
34	3	52	105	158	210	263	316	368	421	474
	4	82	164	246	328	410	493	574	656	738
	5	108	216	324	432	540	648	756	864	972
	6	137	274	412	548	685	822	960	1096	1230
	7	164	328	492	656	820	985	1150	1310	1475
	8	194	388	582	776	970	1165	1360	1550	1745
	9	222	444	666	888	1110	1330	1550	1775	2000
	10	251	502	753	1004	1255	1506	1757	2008	2260
36	3	59	118	177	236	295	354	414	472	530
	4	99	198	297	396	495	594	694	793	890
	5	119	238	357	476	595	715	835	953	1070
	6	152	305	458	610	762	915	1168	1220	1370
	7	184	368	552	735	920	1100	1285	1470	1650
	8	213	426	640	850	1065	1280	1490	1700	1915
	9	245	490	735	980	1230	1470	1720	1965	2210

MULTIPLE VOLUME TABLE—DOUGLAS FIR

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
	10	278	556	835	1110	1390	1665	1945	2220	2500
38	3	65	131	196	262	328	393	458	524	590
	4	97	195	293	390	488	586	684	782	880
	5	133	267	400	534	667	800	935	1070	1200
	6	167	332	502	670	837	1005	1170	1340	1510
	7	200	401	601	802	902	1203	1403	1604	1804
	8	234	468	700	946	1170	1405	1640	1870	2100
	9	271	542	813	1080	1350	1625	1895	2160	2440
	10	306	612	918	1225	1530	1840	2140	2450	2760
40	4	108	217	326	434	543	650	760	868	977
	5	146	293	440	586	734	880	1025	1170	1320
	6	182	364	546	730	910	1090	1275	1455	1640
	7	222	445	667	890	1110	1335	1560	1780	2000
	8	261	522	783	1040	1300	1565	1825	2080	2350
	9	298	597	896	1190	1485	1790	2090	2390	2690
	10	340	680	1020	1360	1700	2040	2380	2720	3060

MULTIPLE VOLUME TABLE—SPRUCE

(Constructed by the Frustum Form Factor method. Based on 189 trees from the Blackfeet and Lolo National Forests.) Scribner Decimal C. Rule.

Number of Trees.

DBH	Logs	1	2	3	4	5	6	7	8	9
8	1	2.5	5.5	8.0	11.0	13.5	16.0	19.0	21.5	24.5
	2	5.0	10.0	13.0	17.5	22.0	26.5	31.0	35.0	39.5
	3	7.5	15.5	23.0	31.0	38.5	46.0	54.0	61.5	69.5
	4	10.5	21.0	32.0	42.5	53.0	63.5	74.0	85.0	95.5
10	1	2.5	5.5	8.0	11.0	14.0	16.5	19.0	22.0	25.0
	2	5.5	10.5	16.0	21.0	26.5	32.0	37.0	42.5	47.5
	3	9.0	18.0	27.0	36.0	45.0	54.0	63.0	72.0	81.0
	4	12.5	25.0	37.5	50.0	62.5	75.0	87.5	100.0	112.5
12	1	3.0	6.0	9.0	12.0	15.0	17.5	20.5	23.5	26.5
	2	6.0	12.5	18.5	24.5	31.0	37.0	43.0	49.0	55.5
	3	10.5	21.0	32.0	42.5	53.0	63.5	74.0	85.0	95.5
	4	15.5	31.0	46.0	61.5	77.0	92.5	108.0	123.0	139.0
14	1	3.0	6.5	9.5	12.5	15.5	19.0	22.0	25.0	28.5
	2	7.0	14.0	21.5	28.5	36.0	43.0	50.0	58.0	64.5
	3	13.0	26.5	39.5	53.0	66.0	79.0	92.5	105.0	119.0
	4	19.0	37.5	56.5	75.0	94.0	113.0	131.5	150.0	169.0
	5	25.0	50.0	75.0	100.0	125.0	150.0	175.0	200.0	225.0
16	1	3.5	7.0	10.5	14.0	17.5	21.0	25.0	28.0	32.0
	2	8.5	17.5	26.0	35.0	43.5	52.0	61.0	69.5	78.0
	3	16.0	32.0	48.5	64.5	80.5	96.5	113.0	129.0	145.0
	4	23.5	47.0	70.5	94.0	117.5	141.0	164.5	188.0	211.0
	5	31.0	61.5	92.5	123.0	154.0	185.0	216.0	246.0	278.0
18	1	4.0	8.0	12.0	16.0	20.0	23.5	27.5	31.5	35.5
	2	10.0	20.0	30.0	40.5	50.5	60.5	70.5	81.0	91.0
	3	19.0	38.0	56.5	75.5	94.5	163.0	132.0	151.0	170.0
	4	29.0	58.0	87.0	116.0	145.0	174.0	203.0	232.0	261.0
	5	38.0	76.0	114.0	152.0	190.0	228.0	266.0	320.0	342.0
	6	47.0	94.0	141.0	188.0	235.0	282.0	329.0	376.0	423.0
20	1	4.5	8.5	13.0	17.0	21.5	26.0	30.0	34.5	38.5
	2	12.0	24.0	35.5	47.5	59.0	71.0	83.0	95.0	107.0
	3	23.5	46.5	70.0	93.0	116.5	140.0	163.0	186.0	210.0
	4	34.0	68.5	102.5	137.0	172.0	205.0	239.0	274.0	308.0
	5	46.0	92.0	137.5	183.5	229.0	275.0	321.0	367.0	413.0
	6	57.5	114.0	172.0	228.0	285.0	342.0	400.0	456.0	514.0
22	1	4	9	14	19	24	28	33	38	43
	2	13	27	41	54	68	81	95	109	122
	3	27	54	82	109	136	164	191	218	246
	4	40	81	122	162	203	244	284	325	365
	5	55	110	165	220	275	330	385	440	495
	6	69	138	207	276	345	414	483	552	620
	7	84	168	252	336	420	504	588	670	755
24	1	5	10	15	21	26	31	36	41	47
	2	16	32	49	65	81	98	114	130	147
	3	31	63	95	126	158	190	221	253	284
	4	48	96	144	192	240	288	336	384	432
	5	64	129	193	258	323	387	452	516	581
	6	81	162	243	324	405	486	568	650	730
	7	97	194	290	387	484	580	677	765	870

MULTIPLE VOLUME TABLE—SPRUCE

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
26	2	18	36	54	72	90	108	126	144	162
	3	37	74	110	147	184	221	258	295	332
	4	55	111	167	222	278	334	390	445	500
	5	74	149	223	298	372	446	520	595	670
	6	94	189	284	378	472	566	660	755	850
	7	115	230	345	460	575	690	805	920	1035
28	3	42	84	126	168	210	252	294	336	378
	4	64	127	191	255	319	383	447	510	574
	5	86	174	258	344	430	516	600	688	774
	6	108	217	325	434	543	650	760	868	976
	7	131	262	393	524	655	786	917	1050	1180
	8	154	308	462	616	770	925	1080	1230	1390
30	3	46	94	140	186	233	279	326	373	420
	4	71	143	214	286	357	430	500	572	644
	5	99	198	297	395	494	594	692	790	890
	6	123	246	368	492	615	740	860	983	1100
	7	150	300	450	600	750	900	1050	1200	1350
	8	175	350	524	700	875	1050	1225	1400	1750
32	3	53	106	159	212	266	319	372	425	478
	4	81	167	245	327	409	490	570	650	735
	5	110	220	330	440	550	660	770	880	990
	6	139	278	417	556	695	834	973	1110	1250
	7	167	334	500	670	836	1000	1170	1335	1500
	8	195	390	585	780	975	1170	1365	1560	1750
34	3	57	114	171	228	285	342	400	456	513
	4	88	177	266	354	443	530	620	710	796
	5	117	234	350	466	584	700	816	934	1050
	6	148	296	434	593	740	890	1035	1185	1330
	7	177	354	530	710	885	1060	1240	1420	1590
	8	210	420	630	840	1050	1260	1470	1680	1890
36	3	61	123	185	246	308	369	430	493	554
	4	93	186	279	372	465	558	650	745	836
	5	125	250	375	500	625	750	875	1000	1250
	6	160	320	480	640	800	960	1120	1280	1440
	7	192	384	575	770	960	1150	1345	1540	1730
	8	224	448	670	895	1120	1340	1560	1790	2010
38	3	67	134	201	268	335	400	470	536	604
	4	100	200	300	400	500	600	700	800	900
	5	136	273	410	545	583	820	955	1090	1225
	6	171	342	514	685	855	1025	1190	1370	1540
	7	205	410	615	820	1025	1230	1435	1640	1845
	8	239	480	720	955	1190	1430	1670	1910	2150
40	4	111	222	333	444	555	666	777	888	999
	5	150	300	450	600	750	900	1050	1200	1350
	6	186	372	558	745	930	1115	1300	1490	1675
	7	228	456	685	910	1140	1370	1600	1820	2025
	8	267	534	800	1170	1330	1600	1865	2130	2400

MULTIPLE VOLUME TABLE—BALSAM

(Constructed by the Frustum Form Factor method. Basis: 33 trees from the Blackfeet National Forest.) Scribner Decimal C Rule.

Number of Trees.

DBH	Logs	1	2	3	4	5	6	7	8	9
8	1	2.5	5	7.5	10	12.5	15	17.5	20	22.5
	2	5.0	10	15.0	20	25.0	30	35.0	40	45.0
	3	8.0	16	24.0	32	40.0	48	56.0	64	72.0
	4	9.0	18	27.0	36	45.0	54	63.0	72	81.0
10	1	3.0	6	9.0	12	15.0	18	21.0	24	27.0
	2	5.5	11	16.5	22	27.5	33	38.5	44	49.5
	3	9.5	19	28.5	38	47.5	57	66.5	76	85.5
	4	13.0	26	39.0	52	65.0	78	91.0	104	117.0
12	1	3.0	6	9.0	12	15.0	18	21.0	24	27.0
	2	6.5	13	19.5	26	32.5	39	45.5	52	58.5
	3	11.0	22	33.0	44	55.0	66	77.0	88	99.0
	4	16.0	32	48.0	64	80.0	96	112.0	128	144.0
14	1	3.5	7	10.5	14	17.5	21	24.5	28	31.5
	2	7.5	15	22.5	30	37.5	45	52.5	60	75.0
	3	14.0	28	42.0	56	70.0	84	98.0	112	126.0
	4	19.5	39	58.5	78	97.5	117	136.5	156	175.0
	5	26.0	52	78.0	108	135.0	162	189.0	216	243.0
16	1	3.5	7	10.5	14	17.5	21	24.5	28	31.5
	2	9.0	18	27.0	36	45.0	54	63.0	72	81.0
	3	17.0	34	51.0	68	85.0	102	119.0	136	153.0
	4	22.5	45	67.5	90	112.5	135	157.5	180	202.5
	5	32.0	64	96.0	128	160.0	192	224.0	256	288.0
18	1	4.0	8	12.0	16	20.0	24	28.0	32	36.0
	2	10.5	21	31.5	42	52.5	63	73.5	84	94.5
	3	20.0	40	60.0	80	100.0	120	140.0	160	180.0
	4	30.5	61	91.5	122	152.5	183	213.5	244	274.5
	5	40.0	80	120.0	160	200.0	240	280.0	320	360.0
20	1	4.5	9	13.5	18	22.5	27	31.5	36	40.5
	2	12.5	25	37.5	50	62.5	75	87.5	100	112.5
	3	25.0	50	75.0	100	125.0	150	175.0	200	225.0
	4	36.0	72	108.0	144	180.0	216	252.0	288	324.0
	5	49.0	98	147.0	196	245.0	294	343.0	393	441.0
	6	66.5	133	199.5	266	333.0	399	466.0	832	599.0
22	1	5	10	15	20	25	30	35	40	45
	2	14	29	43	58	72	87	101	116	130
	3	29	58	87	116	145	174	203	232	261
	4	43	87	130	174	218	261	305	348	391
	5	58	117	175	234	293	351	410	468	526
	6	73	147	220	294	367	441	514	588	661
24	2	17	35	52	70	87	105	122	140	175
	3	34	68	102	136	170	204	238	272	306
	4	51	103	154	206	258	309	360	412	464

MULTIPLE VOLUME TABLE—BALSAM

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
	5	70	140	210	280	350	420	490	560	630
	6	87	175	263	350	437	525	612	700	788
26	2	19	39	58	78	97	117	136	156	175
	3	40	80	120	160	200	240	280	320	360
	4	60	120	180	240	300	360	420	480	540
	5	80	160	240	320	400	480	560	640	720
	6	102	204	306	408	510	612	714	816	918
	7	124	248	372	496	620	744	868	992	1116
	8	143	287	430	573	716	860	1005	1150	1435
28	3	46	92	138	184	230	276	322	387	414
	4	69	139	208	278	348	417	486	586	625
	5	94	188	282	376	470	564	658	752	845
	6	118	236	354	472	590	708	825	944	1060
	7	143	286	429	572	715	858	1000	1145	1285
	8	168	336	504	672	840	1010	1175	1340	1510
30	3	51	102	153	204	255	306	357	408	459
	4	78	196	235	314	392	472	550	628	706
	5	109	218	327	436	545	654	763	872	981
	6	135	270	405	540	675	810	945	1080	1215
	7	165	330	495	660	820	990	1155	1320	1480
	8	192	385	576	770	962	1155	1345	1540	1730

MULTIPLE VOLUME TABLE—WESTERN RED CEDAR

(Based on 186 trees from District I. Diameters are D. I. B. at the top of the 1st log.) Constructed by the Frustum Form Factor Method.
Scribner Decimal C Rule.

Number of Trees.

D.I.B. Top 1st Log	Logs	1	2	3	4	5	6	7	8	9
Inches										
10	1	5.0	10.0	15.0	20.0	25.0	30.0	35.0	40.0	45.0
	2	8.5	17.0	25.5	34.0	42.5	51.0	59.5	68.0	76.5
	3	12.5	25.0	37.5	50.0	62.5	75.0	87.5	100.0	112.5
12	1	8.5	17.0	25.5	34.0	42.5	51.0	59.5	68.0	76.5
	2	11.5	23.0	34.5	46.0	57.5	69.0	80.5	92.0	103.5
	3	16.5	33.0	49.5	66.0	82.5	99.0	115.5	132.0	148.5
	4	21.5	43.0	54.0	64.5	107.5	129.0	150.5	172.0	193.5
14	1	12.0	24.0	36.0	48.0	60.0	72.0	84.0	96.0	108.0
	2	15.0	30.0	45.0	60.0	75.0	90.0	105.0	120.0	135.0
	3	21.5	43.0	54.0	64.5	107.5	129.0	150.5	172.0	193.5
	4	28.0	56.0	84.0	112.0	140.0	168.0	196.0	224.0	252.0
16	1	16.5	33.0	49.5	66.0	82.5	99.0	115.5	132.0	148.5
	2	20.0	40.0	60.0	80.0	100.0	120.0	140.0	160.0	180.0
	3	26.5	52.0	79.5	106.0	132.5	159.0	185.0	212.0	238.0
	4	36.5	73.0	109.5	146.0	182.5	219.0	255.0	292.0	328.0
	5	45.0	90.0	135.0	180.0	225.0	270.0	315.0	360.0	405.0
18	1	22.5	45.0	67.5	90.0	112.5	135.0	157.5	180.0	202.5
	2	25.5	51.0	76.5	102.0	127.5	153.0	178.5	204.0	229.0
	3	35.5	71.0	106.5	142.0	177.5	213.0	248.0	284.0	320.0
	4	46.5	93.0	139.5	186.0	232.0	279.0	326.0	372.0	419.0
	5	57.0	114.0	171.0	228.0	285.0	342.0	399.0	456.0	513.0
	6	67.5	135.0	202.0	270.0	538.0	405.0	472.0	540.0	607.0
20	1	29.0	58.0	87.0	116.0	145.0	174.0	203.0	232.0	261.0
	2	31.5	63.0	94.5	126.0	157.5	189.0	220.0	252.0	283.0
	3	44.5	89.0	133.5	178.0	222.0	267.0	311.0	356.0	400.00
	4	57.5	115.0	172.5	230.0	288.0	345.0	403.0	460.0	518.0
	5	70.5	141.0	211.0	282.0	352.0	423.0	494.0	564.0	635.0
	6	84.5	169.0	254.0	338.0	423.0	506.0	590.0	675.0	706.0
	7	96.5	193.0	290.0	386.0	483.0	580.0	675.0	772.0	870.0
22	1	35	70	105	140	175	210	245	280	315
	2	38	77	115	154	192	231	269	308	346
	3	53	107	160	214	267	321	375	428	482
	4	68	137	205	274	343	411	480	548	616
	5	84	169	254	338	423	506	591	676	760
	6	104	208	312	416	520	624	728	832	936
	7	117	234	351	468	585	702	819	936	1053
24	1	42	85	127	170	212	255	297	340	382
	2	46	92	138	184	230	276	322	368	414
	3	62	125	187	250	312	375	437	500	562
	4	81	163	245	326	407	489	570	652	734
	5	101	202	303	404	505	606	707	808	909
	6	120	240	360	480	600	720	840	960	1080

MULTIPLE VOLUME TABLE—WESTERN RED CEDAR

Number of Trees.—Continued.

D.I.B. Top 1st Log	Logs	1	2	3	4	5	6	7	8	9
	7	138	276	414	550	690	828	965	1105	1240
	8	157	314	470	628	785	942	1100	1255	1410
26	1	52	105	157	210	262	315	367	420	472
	2	56	112	168	224	280	336	392	447	504
	3	76	152	228	304	380	456	533	608	685
	4	98	197	296	394	493	592	690	789	887
	5	120	240	360	480	600	720	840	960	1080
	6	142	284	426	568	710	852	994	1136	1278
	7	165	330	495	660	825	990	1155	1320	1485
	8	187	374	560	748	935	1120	1310	1495	1680
	9	210	420	630	840	1050	1260	1470	1680	1890
28	1	61	122	183	244	305	366	427	488	549
	2	65	130	195	260	325	390	455	520	585
	3	88	176	264	352	440	528	616	704	792
	4	116	232	348	464	580	696	812	928	1044
	5	134	268	402	536	670	804	938	1070	1205
	6	166	332	498	664	830	996	1160	1330	1490
	7	192	384	576	768	960	1150	1345	1535	1730
	8	217	434	650	868	1085	1300	1520	1735	1950
	9	245	490	735	980	1220	1470	1715	1960	2020
	10	270	540	810	1080	1350	1620	1890	2160	2430
30	1	69	138	207	276	345	414	483	552	621
	2	73	146	219	292	365	438	510	584	957
	3	98	197	296	394	493	592	690	789	887
	4	129	258	387	516	645	774	903	1030	1160
	5	159	318	477	636	795	954	1110	1270	1430
	6	189	379	568	758	947	1140	1330	1515	1705
	7	222	444	666	888	1110	1330	1550	1775	1995
	8	251	502	753	1004	1255	1505	1755	2010	2260
	9	278	556	835	1110	1390	1665	1945	2220	2500
	10	311	622	933	1244	1555	1866	2177	2488	2799
32	1	77	155	233	310	388	465	543	620	697
	2	81	163	244	326	408	490	570	652	734
	3	113	226	339	452	565	678	791	904	1017
	4	147	294	341	588	735	882	1030	1175	1320
	5	182	365	548	730	912	1095	1280	1460	1640
	6	205	410	615	820	1025	1230	1435	1640	1845
	7	249	498	746	995	1245	1495	1740	1990	2240
	8	282	564	845	1130	1410	1690	1975	2260	2540
	9	318	636	994	1275	1590	1910	2225	2550	2860
	10	352	704	1056	1410	1760	2110	2460	2820	3170
34	1	84	168	252	336	420	504	589	672	756
	2	88	176	264	352	440	528	616	704	792
	3	123	246	307	369	492	615	738	860	984
	4	162	324	486	648	810	972	1135	1296	1458
	5	199	398	597	796	995	1194	1393	1592	1790
	6	239	478	717	956	1195	1435	1673	1912	2152
	7	278	556	834	1110	1390	1670	1945	2225	2500
	8	318	636	954	1272	1590	1910	2225	2545	2860
	9	357	714	1070	1430	1785	2140	2500	2860	3210
	10	415	830	1245	1660	2075	2490	2900	3320	3735

MULTIPLE VOLUME TABLE—WESTERN RED CEDAR

(Based on 186 trees from District I. Diameters are DBH.) Constructed by deriving volumes from DIB (top 1st log) volume curves.
Scribner Decimal C. Rule.

Number of Trees.

DBH	Logs	1	2	3	4	5	6	7	8	9
Inches										
10	1	3.0	6.0	9.0	12.0	15.0	18.0	21.0	24.0	27.0
	2	6.5	13	19.5	26	32.5	39	45.5	52	58.5
	3	9	18	27	36	45	54	63	72	81
	4	10.5	21	31.5	42	52.5	63	73.5	84	94.5
12	1	5	10	15	20	25	30	35	40	45
	2	8	16	24	32	40	48	56	64	72
	3	11.5	23	34.5	46	57.5	69	80.5	92	103.5
	4	15	30	45	60	75	90	105	120	135
14	1	7.5	15	22.5	30	37.5	45	52.5	60	67.5
	2	10.5	21	31.5	42	52.5	63	73.5	84	94.5
	3	15	30	45	60	75	90	105	120	135
	4	21	42	63	84	105	126	147	168	189
16	1	10	20	30	40	50	60	70	80	90
	2	13.5	27	40.5	54	67.5	81	94.5	108	121.5
	3	18.5	37	55.5	74	92.5	111	129.5	148	166.5
	4	25	50	75	100	125	150	175	200	225
	5	31.5	63	94.5	126	157.5	189	220	252	284
18	1	13	26	39	52	65	78	91	104	117
	2	16.5	33	49.5	66	82.5	99	115.5	132	148.5
	3	23	46	69	92	115	138	161	184	207
	4	30	60	90	120	150	180	210	240	270
	5	37.5	75	112.5	150	187.5	225	262	300	337
20	1	16	32	48	64	80	96	112	128	144
	2	19	39	57	76	95	114	133	152	171
	3	26.5	53	79.5	106	132.5	159	185	212	238
	4	35	70	105	140	175	210	245	280	315
	5	44	88	132	176	220	264	308	352	396
22	1	19	39	58	78	97	117	136	156	175
	2	22	45	67	90	112	135	157	180	202
	3	31	63	94	126	157	189	220	252	284
	4	41	82	123	164	205	246	287	328	369
	5	51	103	154	206	258	309	361	413	464
24	1	22	45	67	90	112	135	157	180	202
	2	26	52	78	104	130	156	182	208	234
	3	36	72	108	144	180	216	252	288	324
	4	46	93	139	186	232	279	326	372	418
	5	58	117	175	234	292	351	410	468	526
	6	70	140	210	280	350	420	490	560	630
26	1	26	53	79	106	132	159	185	212	238
	2	29	59	88	118	147	177	206	236	266
	3	40	81	121	162	202	243	284	324	364
	4	53	106	159	212	265	318	371	424	477
	5	66	132	198	264	330	396	462	528	594
	6	79	158	237	316	395	474	554	632	711
	7	92	184	276	368	460	552	644	736	829
28	1	30	60	90	120	150	180	210	240	270
	2	33	66	99	132	165	198	231	264	297
	3	45	91	136	182	228	273	318	364	410
	4	59	118	177	236	295	354	413	472	531
	5	73	147	220	294	368	441	515	588	661
	6	87	175	262	350	437	525	613	700	788

MULTIPLE VOLUME TABLE—WESTERN RED CEDAR

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
	7	101	203	304	406	507	609	710	812	913
30	1	33	66	99	132	165	198	231	264	297
	2	36	73	109	146	182	219	256	292	328
	3	50	100	150	200	250	300	350	400	450
	4	65	130	195	260	325	390	455	520	585
	5	80	161	242	322	403	483	564	644	725
	6	95	191	286	382	478	573	669	764	860
	7	111	222	333	444	555	666	777	888	999
32	1	37	75	112	150	187	225	262	300	337
	2	41	82	123	164	205	246	287	328	369
	3	56	112	168	224	280	336	392	448	504
	4	72	145	217	290	362	435	508	580	653
	5	90	180	270	360	450	540	630	720	810
	6	106	213	320	426	532	640	745	852	960
	7	124	248	372	496	620	744	868	992	1116
34	1	41	83	124	166	208	249	291	332	374
	2	45	90	135	180	225	270	315	360	405
	3	61	123	184	246	307	369	431	492	554
	4	80	160	240	320	400	480	560	640	720
	5	99	198	297	396	495	594	693	792	891
	6	117	234	351	469	585	702	820	936	1053
	7	136	272	408	544	680	816	953	1090	1225
	8	155	310	465	620	775	930	1085	1240	1390
36	1	46	92	138	184	230	276	322	368	414
	2	49	99	148	198	247	297	346	396	446
	3	67	134	200	268	335	400	469	536	600
	4	87	175	262	350	437	525	613	700	788
	5	108	217	326	434	543	651	760	869	978
	6	127	255	382	510	638	765	893	1020	1148
	7	149	298	447	596	745	895	1042	1190	1340
	8	169	338	506	676	845	1015	1185	1351	1520
38	2	54	109	163	218	272	327	382	436	490
	3	74	148	222	296	370	444	518	592	666
	4	96	193	290	386	483	579	676	772	870
	5	119	238	357	476	595	714	833	952	1071
	6	140	280	420	560	700	840	980	1120	1400
	7	163	326	490	653	815	980	1140	1305	1465
	8	186	372	558	744	930	1115	1300	1440	1675
	9	210	420	630	840	1050	1260	1470	1680	1890
40	2	58	117	176	234	292	351	410	468	526
	3	79	159	238	318	397	477	556	636	716
	4	104	208	312	416	520	624	728	832	936
	5	128	256	384	512	640	758	896	1025	1150
	6	150	300	450	600	750	900	1050	1200	1350
	7	176	352	528	704	880	1055	1230	1410	1585
	8	201	402	603	804	1005	1206	1407	1608	1809
	9	226	452	678	904	1130	1355	1580	1810	2040
42	3	86	172	258	344	430	516	602	688	774
	4	112	225	338	450	563	675	788	900	1015
	5	139	277	416	554	693	830	970	1110	1245
	6	162	324	486	648	810	972	1135	1295	1460
	7	190	380	570	760	950	1140	1330	1520	1710
	8	218	435	653	870	1090	1305	1520	1740	1960
	9	244	488	732	976	1220	1460	1710	1950	2200

MULTIPLE VOLUME TABLE—WESTERN RED CEDAR

Number of Trees.—Continued.

DBH	Logs	1	2	3	4	5	6	7	8	9
	10	269	538	807	1075	1345	1615	1880	2150	2420
44	3	94	187	280	374	467	561	655	748	841
	4	122	244	366	488	610	732	854	976	1100
	5	150	300	450	600	750	900	1050	1200	1350
	6	176	351	527	702	878	1052	1230	1400	1580
	7	206	412	618	824	1030	1236	1442	1648	1854
	8	235	471	706	942	1178	1412	1650	1885	2120
	9	265	530	794	1060	1320	1590	1850	2120	2380
	10	291	583	874	1160	1450	1745	2040	2330	2620
46	3	100	201	302	402	503	603	704	804	905
	4	131	262	393	524	655	785	917	1050	1180
	5	161	322	483	645	805	966	1130	1290	1450
	6	188	376	564	752	940	1130	1315	1500	1690
	7	222	444	666	888	1110	1330	1550	1775	2000
	8	253	506	760	1010	1265	1520	1770	2020	2280
	9	284	568	850	1135	1420	1700	1990	2270	2560
	10	315	630	945	1260	1575	1890	2200	2520	2840
48	3	118	236	354	472	590	710	826	945	1060
	4	140	280	420	560	700	840	980	1120	1260
	5	172	344	516	678	860	1030	1205	1375	1550
	6	202	404	606	808	1010	1212	1404	1616	1818
	7	237	474	711	948	1185	1420	1660	1895	2130
	8	271	542	823	1080	1355	1625	1895	2170	2440
	9	305	610	915	1220	1525	1830	2135	2440	2745
	10	341	682	1020	1360	1700	2025	2385	2730	3070
50	4	148	296	444	592	740	888	1040	1185	1330
	5	181	363	544	726	908	1090	1270	1450	1630
	6	215	430	645	860	1075	1290	1505	1720	1935
	7	251	502	753	1004	1255	1506	1757	2008	2259
	8	288	575	863	1150	1435	1725	2005	2300	2590
	9	322	644	966	1290	1610	1930	2260	2580	2900
	10	368	736	1105	1470	1840	2210	2580	2940	3310
52	4	155	311	389	467	622	778	1009	1245	1400
	5	191	381	572	763	953	1140	1335	1525	1905
	6	228	455	684	910	1140	1365	1590	1820	2050
	7	264	528	792	1055	1320	1585	1850	2110	2380
	8	304	607	910	1210	1515	1820	2120	2430	2730
	9	342	685	1025	1370	1710	2050	2400	2740	3080
	10	396	792	1190	1585	1980	2380	2770	3170	3560

MULTIPLE VOLUME TABLE—LODGE POLE PINE

(NOTE—Trees 10 inches and up over two logs, based on 1808 trees in Gallatin County. Other measurements taken in Deer Lodge County, Montana.)

No. of Trees.

DBH	Logs	1	2	3	4	5	6	7	8	9
.7	1	1	2	3	4	5	6	7	8	9
8	1	2	4	6	8	10	12	14	16	18
	2	4	8	12	16	20	24	28	32	36
9	1	2.5	5	7.5	10	12.5	15	17.5	20	22.5
	2	5	10	15	20	25	30	35	40	45
10	1	3.5	7	10.5	14	17.5	21	24.5	28	31.5
	2	6	12	18	24	30	36	42	48	54
	3	9	18	27	36	45	54	63	72	81
	4	12.5	25	37.5	50	62.5	75	87.5	100	112.5
11	1	4.5	9	13.5	18	22.5	27	31.5	36	40.5
	2	7	14	21	28	35	42	49	56	63
	3	10	20	30	40	50	60	70	80	90
	4	14	28	42	56	70	84	98	112	126
12	1	5	10	15	20	25	30	35	40	45
	2	8	16	24	32	40	48	56	64	72
	3	11.5	23	34.5	46	57.5	69	80.5	92	103.5
	4	16	32	48	64	80	96	112	128	144
13	1	6	12	18	24	30	36	42	48	54
	2	9	18	27	36	45	54	63	72	81
	3	13	26	39	52	65	78	91	104	117
	4	18	36	54	72	90	108	126	144	162
14	1	7	14	21	28	35	42	49	56	63
	2	10.5	21	31.5	42	52.5	63	73.5	84	94.5
	3	15	30	45	60	75	90	105	120	135
	4	21	42	63	84	105	126	147	168	189
	5	28	56	84	112	140	168	196	224	252
15	1	8	16	24	32	40	48	56	64	72
	2	12	24	36	48	60	72	84	96	108
	3	16.5	33	49.5	66	82.5	99	115.5	132	148.5
	4	24	48	72	96	120	144	168	192	216
	5	32.5	65	97.5	130	162.5	195	227.5	260	292.5
16	1	9	18	27	36	45	54	63	72	81
	2	13.5	27	40.5	54	67.5	81	94.5	108	121.5
	3	19	38	57	76	95	114	133	152	171
	4	27	54	81	108	135	162	189	216	243
	5	36.5	73	109.5	146	182.5	219	255.5	292	328.5
17	1	10.5	21	31.5	42	52.5	63	73.5	84	94.5
	2	15	30	45	60	75	90	105	120	135
	3	21.5	43	64.5	86	107.5	129	150.5	172	193.5
	4	30.5	61	91.5	122	152.5	183	213.5	244	274.5
	5	40.5	81	121.5	162	202.5	243	283.5	324	364.5
18	1	12	24	36	48	60	72	84	96	108
	2	16.5	33	49.5	66	82.5	99	115.5	132	148.5
	3	24	48	72	96	120	144	168	192	216
	4	34	68	102	136	170	204	238	272	306

MULTIPLE VOLUME TABLE—LODGE POLE PINE

Number of Trees.—Continued.

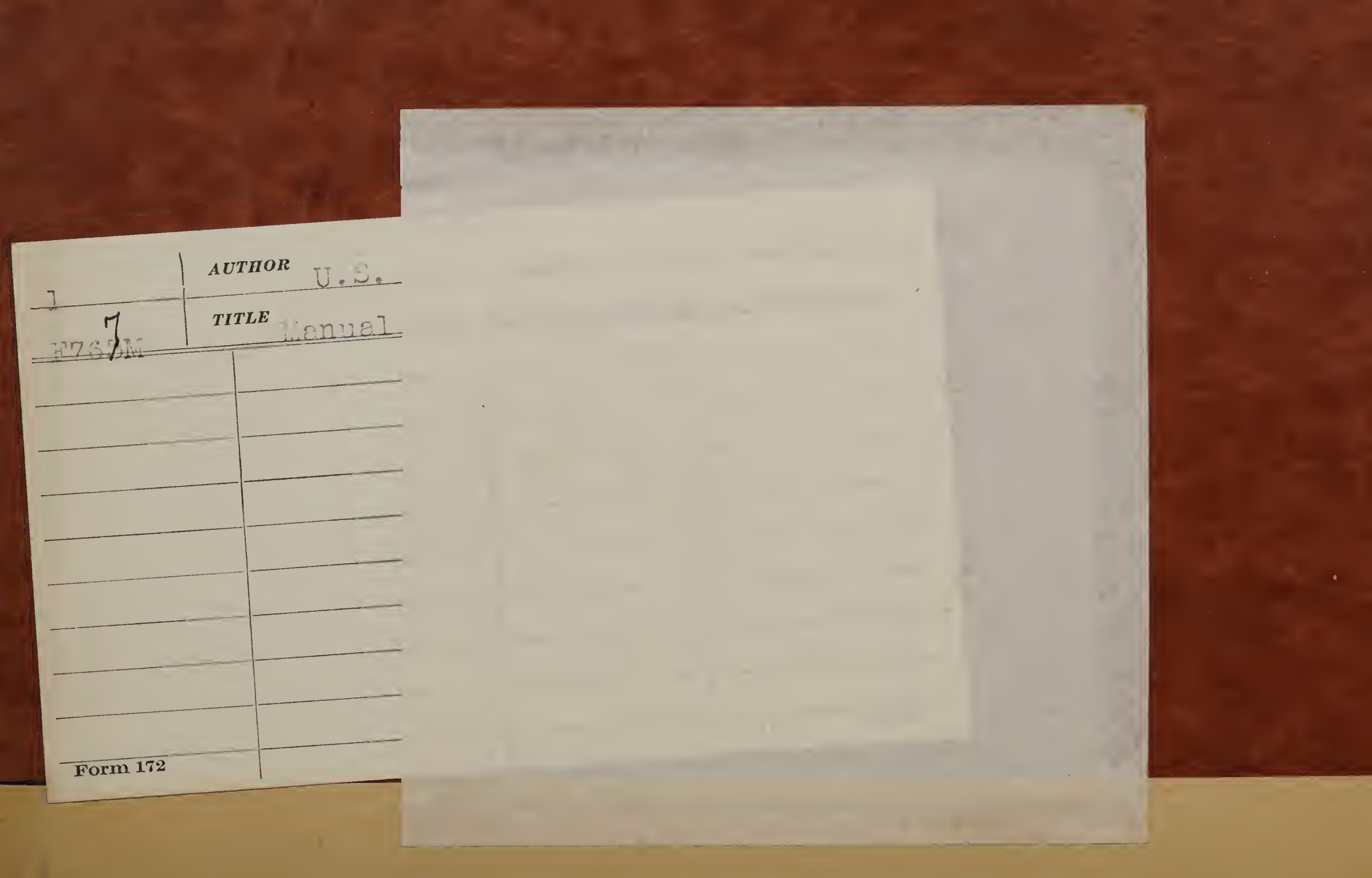
Number of Trees.

DBH	Logs	1	2	3	4	5	6	7	8	9
	5	44.5	89	133.5	178	222.5	267	311.5	356	400.5
19	1	13.5	27	40.5	54	67.5	81	94.5	108	121.5
	2	19.5	39	58.5	78	97.5	117	136.5	156	175.5
	3	27	54	81	108	135	162	189	216	243
	4	37.5	75	112.5	150	187.5	225	262.5	300	337.5
	5	48.5	97	145.5	194	242.5	291	339.5	388	436.5
20	1	15	30	45	60	75	90	105	120	135
	2	22	44	66	88	110	132	154	176	198
	3	30	60	90	120	150	180	210	240	270
	4	41	82	123	164	205	246	287	328	369
	5	52.5	105	157.5	210	262.5	315	367.5	420	472.5
21	1	17	34	51	68	85	102	119	136	153
	2	24.5	49	73.5	98	122.5	147	171.5	196	220.5
	3	33	66	99	132	165	198	231	264	297
	4	45	90	135	180	225	270	315	360	405
	5	56.5	113	169.5	226	282.5	339	395.5	452	508.5
22	3	36.5	73	109.5	146	182.5	219	255.5	292	328.5
	4	48.5	97	145.5	194	242.5	291	339.5	388	436.5
	5	60.5	121	181.5	242	302.5	363	423.5	484	544.5
23	3	40	80	120	160	200	240	280	320	360
	4	52.5	105	157.5	210	262.5	315	367.5	420	472.5
	5	65	130	195	260	325	390	455	520	585
24	3	44	88	132	176	220	264	308	352	396
	4	56.5	113	169.5	226	282.5	339	395.5	452	508.5
	5	69	138	207	276	345	414	483	552	621

TIMBER RECONNAISSANCE COST SHEET

Forest ..... Project ..... Month .....

NAME	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	SALARY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TITLE Manual
Form 172